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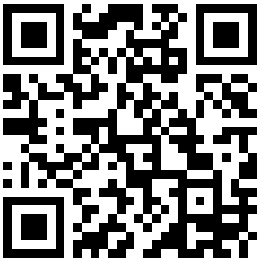

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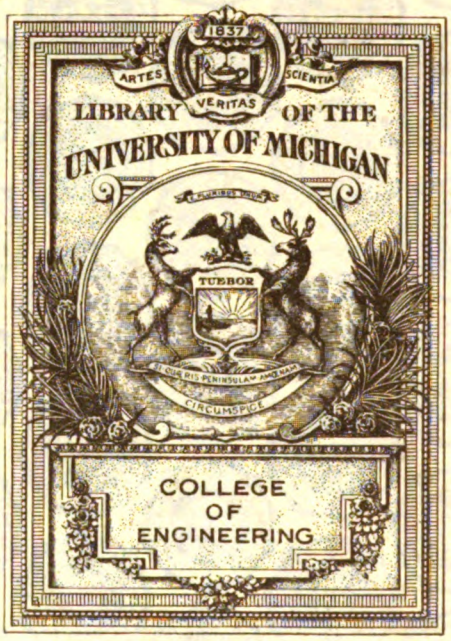

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Popular Radio

JANUARY · 1927 ★

25¢

—In this Issue—

THE NEW CIRCUIT BY KENNETH HARKNESS

See page 14

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more distance on the *same* set

Want more stations on that storage battery set of yours? Want the far-away ones you get now to come in more easily and regularly? The Radiotron laboratories have developed a *super-detector* that slips right into the socket where you have a Radiotron UX-201-A now. Just change that one to a Radiotron UX-200-A.

It makes your set sensitive to fainter signals—reaches out to farther stations—picks up weaker ones you couldn't get before. It makes a big change for a very small cost!

Bring your storage battery set up-to-date with
a power RADIOTRON UX-171 or UX-112
a detector RADIOTRON UX-200-A
and RADIOTRONS UX-201-A for all-round quality.

Bring your dry battery set up-to-date with
a power RADIOTRON UX-120
and RADIOTRONS UX-199 for all-round quality.

RADIO CORPORATION OF AMERICA
New York Chicago San Francisco

HEATING METAL INSIDE OF GLASS

EVERYONE knows that glass melts easily, and metal requires a high temperature. Yet, at the Radiotron laboratories, the experimenters can put a Radiotron in the coil of a "high frequency furnace" and melt the metal *inside it* without melting the glass. This is done by an electric current that is induced inside the glass bulb, right through the glass.

This extraordinary furnace is not only used for experiment. In manufacture, every single Radiotron goes for a moment through such a furnace, just after the air has been exhausted out of it. The inside metal is heated red hot in the vacuum, and the tiny air bubbles boil right out of the metal and the glass, and are pumped away. Never before could such an exhaust be obtained.

This means *real performance* when the Radiotron gets into your set. And it adds another reason for insisting on a genuine RCA Radiotron with the RCA mark on the base and the glass. There are Radiotrons for every purpose.

RCA

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA

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APPROVED BY 18 MONTHS OF PUBLIC USE

NO OTHER BATTERY IS LIKE IT

Eveready Layerbilt "B" Battery No. 486, the Heavy-Duty battery that should be specified for all loud-speaker sets.

The Layerbilt patented construction revealed. Each layer is an electrical cell, making automatic contact with its neighbors, and filling all available space inside the battery case.

Practical tests have shown this to be the most economical of "B" Batteries

IN DAILY use in the home, Eveready Layerbilt "B" Battery No. 486 has fulfilled the promises made for it in laboratory tests. More than a year's study of the performance of this battery in the hands of the public has shown that it is the most satisfactory and most economical "B" battery ever developed. All loud-speaker sets require Heavy-Duty batteries—and the Layerbilt has proved itself absolutely the best of them all.

If you are now using the smaller, Light-Duty batteries, the Eveready Layerbilts will give you twice the service though they do not cost anything like twice as much. If you are already using Heavy-Duties, the Layerbilt, the longest lasting Heavy-Duty ever built, will run your set at least 25% longer, and again you will save money. Unless Eveready Layerbilts now are connected to your set, you spend more on "B" batteries than you should, and you can have no idea how good a "B" battery can be. The Layerbilt holds a surprise in store for you.

Eveready Layerbilt's unequaled service is due to its unique construction. All other dry cell "B" batteries are made of cylindrical cells, with many soldered connections, and a great deal of space is wasted between the cells. The Layerbilt is built up of layers of *flat* current-producing elements, that make connection with each other automatically, and that fill all available space inside the battery case. It is every inch a battery. In it you get more active materials than in any other battery and the Layerbilt construction makes those materials much more efficient current producers.

Those are the convincing reasons why the Eveready Layerbilt has proved itself the longest lasting, most economical and reliable "B" battery ever built.

Just remember this about "B" batteries—Heavy-Duty batteries are more economical than the smaller Light-Duty batteries on all loud-speaker sets, and the patented exclusive Eveready Layerbilt No. 486 is the most economical of all.

Manufactured and guaranteed by

NATIONAL CARBON CO., INC.

New York San Francisco

Canadian National Carbon Co., Limited
Toronto, Ontario

Tuesday night is Eveready Hour Night—9 P. M., Eastern Standard Time, through the following stations:

WEAF–*New York*	WTAM–*Cleveland*
WJAR–*Providence*	WWJ–*Detroit*
WEEI–*Boston*	WGN–*Chicago*
WTAG–*Worcester*	WOC–*Davenport*
WFI–*Philadelphia*	WCCO–*Minneapolis* / *St. Paul*
WGR–*Buffalo*	
WCAE–*Pittsburgh*	KSD–*St. Louis*
WSAI–*Cincinnati*	WRC–*Washington*

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Popular Radio

EDITED *by* KENDALL BANNING

FOUNDED 1911

VOLUME XI | January, 1927 | NUMBER 1

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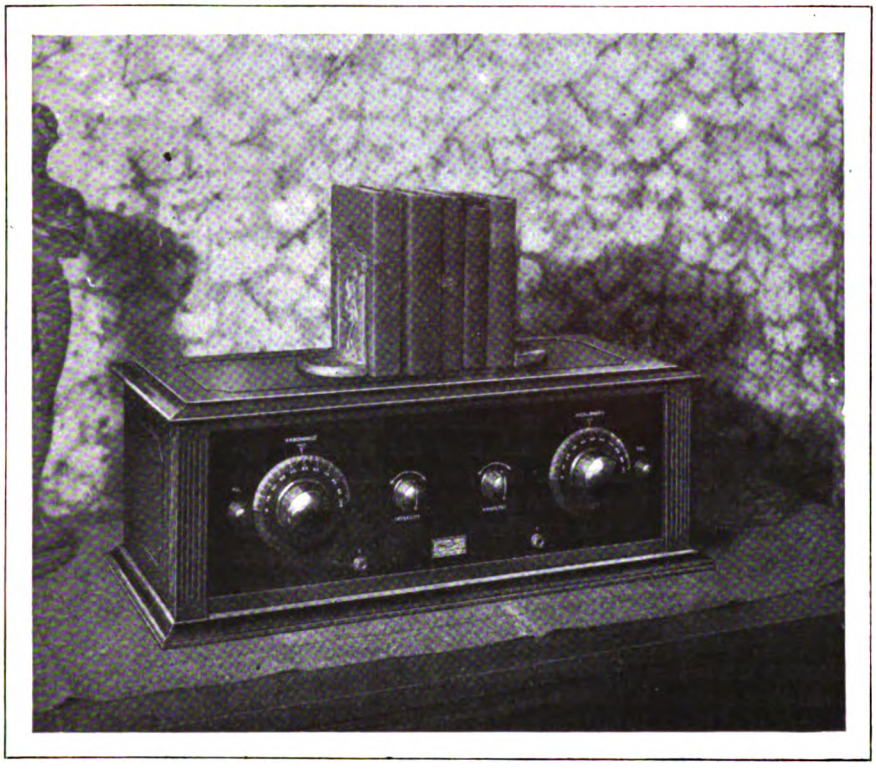
BROWNING-DRAKE RADIO



TESTED... Then Highly ENDORSED

SINCE its introduction several years ago, Browning - Drake Radio has been TESTED by thousands of radio experts throughout the world . . . then wholeheartedly ENDORSED for dependable radio reception. This unusual endorsement has put Browning-Drake into a hundred thousand homes where Browning-Drake performance is giving permanent satisfaction to its owners.

During the summer of 1923, at Cruft Laboratory of Harvard University, Glenn H. Browning and Frederick H. Drake set a mathematical standard of design for radio frequency transformers. This scientific achievement resulted in the Browning-Drake slot wound radio frequency transformer. By using one stage of scientifically designed radio frequency, incorporating the Browning-Drake transformer, together with the flexibility of dual-control tuning, a combination was found that has never been surpassed for all around radio reception.

Browning Drake produces only one model . . . the Browning-Drake Five which is completely assembled at its Brighton laboratories. Every set is unconditionally guaranteed. You will find the price of only $95.00 as amazing as its performance. Ask the nearest Browning-Drake dealer to demonstrate it for you TODAY.

DEALERS: No reputable dealer can afford to overlook the Browning-Drake opportunity. Every Browning-Drake dealer has made money and every customer has been permanently pleased. Write or wire TODAY for proposition.

BROWNING-DRAKE CORPORATION, Brighton, Mass.

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A Page With The Editor

With this issue of Popular Radio the department "What's New in Radio," which was instituted about four years ago as a regular feature of the magazine, has been greatly expanded—in deference to the expressed wishes of our readers for more extensive information concerning the many new and useful inventions that are being placed at their disposal by the radio industry.

* *

Inventors, experimenters, manufacturers and readers generally are invited to keep the Popular Radio Laboratory informed of all new apparatus that is of their own creation or that comes to their attention; if the apparatus passes the tests of the laboratory, it will be duly recorded in that Department, for the information and benefit of all.

* *

In view of the increased space given to "What's New In Radio" in this number, Dr. Free's Department "In the World's Laboratories" has been omitted this month. It will be resumed in the February issue and at greater length than usual.

* *

In the interests of the two million or more broadcast listeners within a hundred-mile radius of New York, where radio reception is occasionally marred by code signals from the old-time spark transmitter that is still in service at the Brooklyn Navy Yard, the Editor took up with the naval authorities the question of doing away with this form of interference from this particular source.

* *

With characteristic promptness, Rear Admiral C. P. Plunkett sends the readers of Popular Radio the following re-assuring message:

* *

"My inquiry shows that we have been engaged for some time in converting our old-fashioned transmitter so as to avoid interference of every kind. We use a low-power tube set most of the time, but occasionally we get a message from far at sea, where we have to revert to the old transmitter. This, however, will be shortly remedied and I trust there will be no further complaint.

* *

"I thank you very much for calling my attention to it, as I had only observed very occasional interference and hope to have it eliminated entirely."

* *

When the Actors' Equity Association —which includes in its membership most of our important actors and actresses— recently forbade the broadcasting of a direct-from-the-stage performance of "The Miracle" from Station WIP of Philadelphia and WGBS of New York, unless the members of the cast received a bonus of one-eighth of their weekly salaries, the Editor invited the amiable Mr. Frank Gillmore, their executive secretary, to explain the reason for Equity's action.

* *

To the observer on the side lines, there seems to be little if any reason for demanding extra pay for the cast, in view of the fact that the broadcasting of a play during an actual stage presentation entails no additional work to the performers, and indeed may be done without the knowledge of the cast.

* *

The gist of Mr. Gillmore's explanation follows:

* *

"The Actors' Equity Association is quite willing to allow its members to broadcast, and many of them do so regularly. It does insist that when any member, or members, broadcast the play in which they are currently appearing, or any part of that play, that they should be paid for it. And it has set the rate for that pay at one-eighth of their weekly salary, which is the rate charged for an extra performance whenever it is required.

* *

"Now then, why has Equity thought it necessary, or advisable to make, and to enforce such a ruling?

* *

"When radio was very much of a novelty, and some of the theatrical managers were quick to jump at this new way of presenting their attractions before potential audiences, individual actors and entire companies were sent to broadcasting stations to perform scenes, or whole plays in which they were appearing.

* *

"But the actors learned that any benefit which accrued from these performances was for the radio companies which sold sets or parts, and needed entertainment in order to interest prospective purchasers in their possession, and for the management of the plays in which they were appearing.

* *

"The actors found that these performances for five hundred thousand or five million people did not bring them any more or better contracts, but it did bring them a good deal of extra work from which other people were profiting; either directly in money, or indirectly, in good will.

* *

"That is the basis of Equity's ruling; where there is extra work there should be extra pay. It is counted fair in all other lines of work, why should it not be fair for people of the theatre?

"And although the ruling of extra pay for performances was at first applied only to special performances, because of its classification as an advertising stunt, the Council of this Association extended the ruling to cover all radio performances, whether picked up from the stage during a performance, or not."

* *

But does this answer the Editor's query?

* *

The issue involved is of academic rather than of practical import, after all. Stage plays are written for presentation on the stage, where the appeal is to both the ear and the eye; the only theatrical performances that are successfully sent "on the air" are those which are broadcast from the studio, with the aid of explanatory remarks, a proper acoustical background and "off-stage" effects.

* *

To this observer on the side lines it still appears that the broadcasting of a play during an actual performance is of far greater publicity value to the production, and in this way reacts to the advantage of both the producers and to the cast, than it is of benefit to the broadcast listener.

* *

"May I take this rather belated opportunity of very heartily congratulating you on the new Popular Radio which is now, in my estimation, the finest radio magazine to be found in the world. It is my intention to keep all the copies of P.R. for binding."
—W. Bradley (G-2AUX), *10 Montenotte Road, London, N. 8, England.*

* *

In Popular Radio for next month—February—will appear two constructional articles.

* *

One will give instructions for building the Rauland-Lyric Amplifier, at a cost for parts not to exceed $29.00.

* *

The other article will tell how to assemble the All-Amax Senior 3-tube Reflex receiver, at a cost for parts not to exceed $44.00.

* *

And in the March number will be published a constructional article of interest to all set owners—an article that will tell how to build your own cone loudspeaker at home.

Kendall Banning

Editor, Popular Radio

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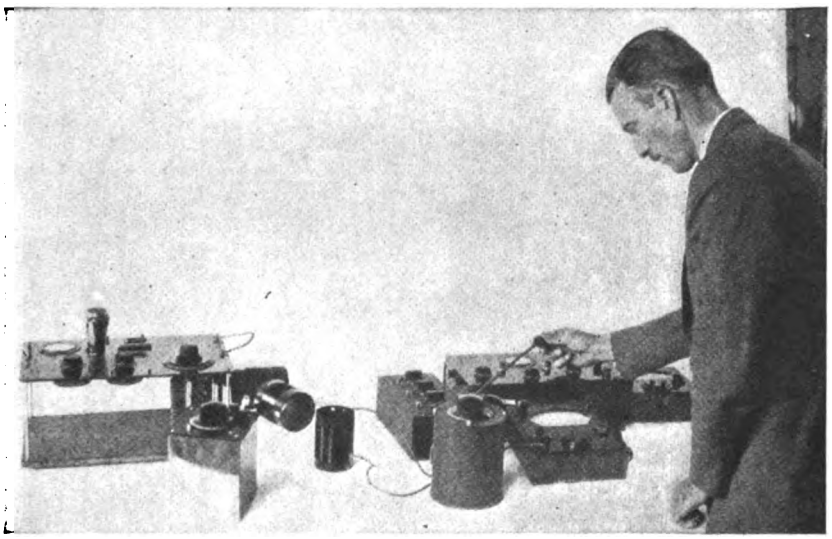

From a photograph made for POPULAR RADIO

POPULAR RADIO a Vital Factor in the Development of Radio

"POPULAR RADIO has been a vital factor in the development of the radio industry, for not only has it encouraged independent experimentation on all types of radio receivers but it has given to the 'fan' the scientific facts upon which to base his work."

G. H. Browning

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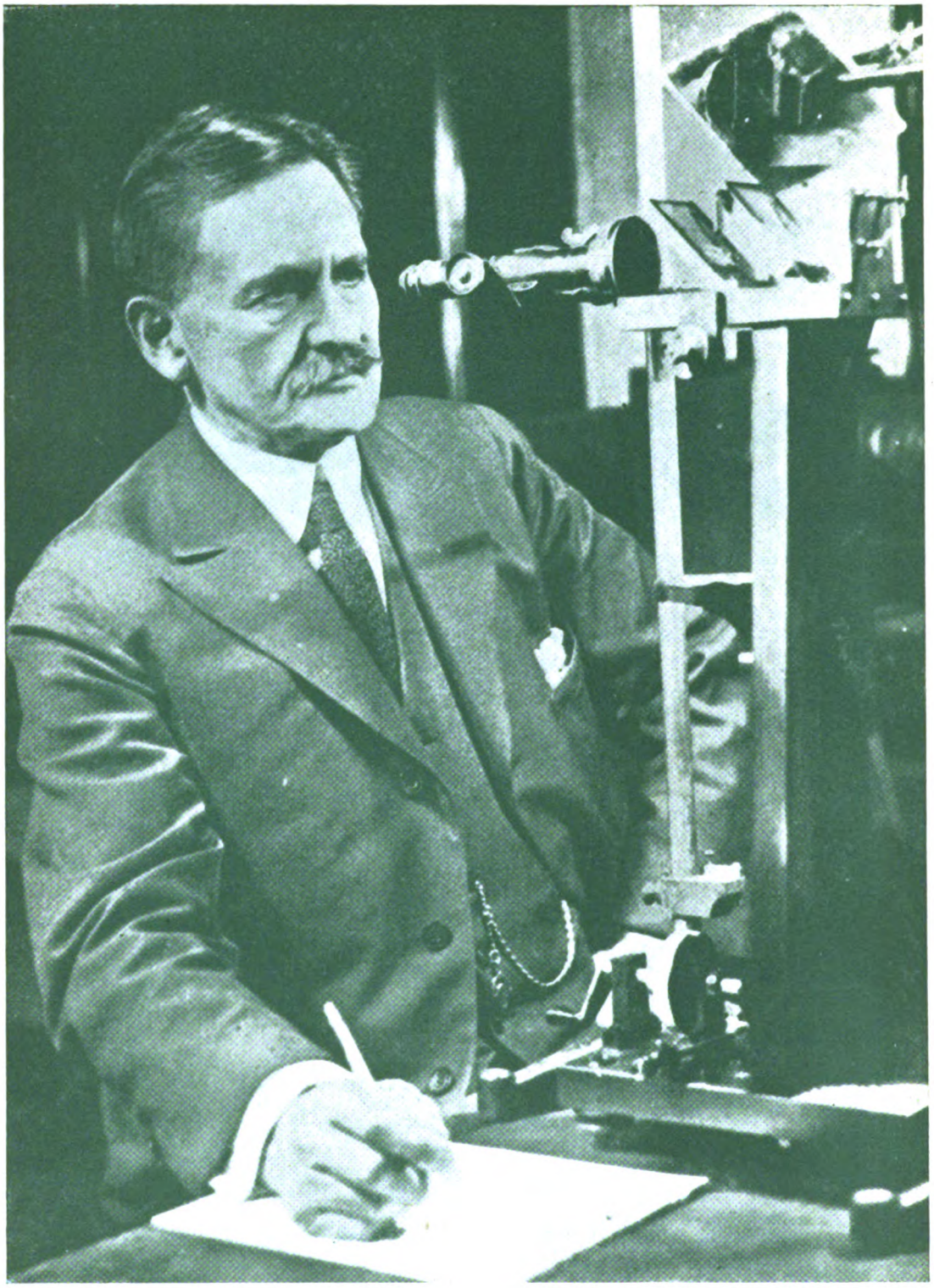

Underwood & Underwood

He Corrects the Speed Measurements of Radio Waves

PROFESSOR ALBERT A. MICHELSON *of the University of Chicago, dean of American physicists, at the recent meeting of the National Academy of Sciences, at Philadelphia, described the results of three years work on two mountain tops in California to determine the speed of light through space. His latest figure for this most fundamental of all the constants of Nature is 186,284 miles a second—replacing the formerly accepted figure of 186,326 miles a second. As radio waves are believed to have the same speed as light waves, Dr. Michelson's new figure applies also to them.*

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Popular Radio

VOLUME XI January, 1927 NUMBER 1

WHO WILL PAY THE MAN

Who Pays the Broadcaster?

The practical part that the broadcast listener is playing—and must play—to maintain and develop radio programs

MILLIONS of dollars are invested today in broadcasting stations in the United States.

Millions more are being spent yearly on programs broadcast from these stations.

Most of this vast sum is paid for the maintenance of the 500 or more broadcast stations that are supported for the purpose of creating good will on the part of the radio audience toward the concerns that pay the bills.

These concerns are paying the bills because they believe that they are thus building up what the psychologists tell us is "a subconscious buying attitude" toward the products, or toward the merchandise, or toward the professional or other services, or whatever it is that these broadcasters have to sell.

Many of the broadcasting stations (the number of which at the present time is probably over 100) are becoming frankly "toll stations." They are renting out time on a rate-basis that each station determines separately on the basis of the area that it covers, and its influence as gauged by its estimated audience, and other factors.

The year 1927 is destined to see a rapid growth in the number of these "toll" stations.

At present most of the program features of outstanding merit and popularity are supported by business concerns that not only pay the toll station charges, but the fees of the artists as well—to say nothing of the innumerable incidental expenses incurred.

From these large expenditures the radio audience benefits. It will continue to benefit as long as these programs are continued.

But the programs will be continued only as long as those who pay the bills have reason to believe that the large amount thus invested brings back returns from the radio audience.

We, of the broadcast audience, the "broadcatchers," will be able to listen-in on the great symphony concerts, upon the recitals of the world's greatest artists, upon athletic events of nation-wide interest, upon the voices of our statesmen, of our scientists, of our other leaders of eminence only so long as the broadcaster has reason to believe that the enormous expense that this service involves is justified on economic grounds.

POPULAR RADIO believes that the time has come when the radio audience not only can but should, in the interest of better broadcasting, convert this "subconscious" good will toward the patrons of radio broadcasting, to conscious and direct support of those who are maintaining the radio programs.

POPULAR RADIO believes that the most effective method of lending substantial aid and direct encouragement to those who are demonstrating their faith in this method of creating good will, and who are giving their effort and their substance to the development of a form of public service that has already become the established and important factor

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in our American civilization may be expressed thus:

To support those who are supporting radio broadcasting.

The following article tells who some of these outstanding patrons of broadcasting are and what they are paying to win the good will of the radio audience—your good will and mine.

—EDITOR

By ORRIN E. DUNLAP, JR.

WHEN it was announced that the broadcasting rights of the Jack Dempsey - Gene Tunney heavyweight championship fight had been purchased by George Ed Smith, President of the Royal Typewriter Company, there were a host of business men who asked:

"What can a business concern profit from such a connection?"

Furthermore, their inquiry was given more significance when it was reported that the broadcasting costs ran upwards of $25,000.

The network of WEAF costs $4,080 for an hour hook-up. On the night of the fight the stations went on the air with the preliminary bouts and sidelights at 7:30 o'clock, making a total cost of at least $12,000. In addition to WEAF's allied transmitters there were others linked into the circuit, including WJZ and affiliated stations. It was reported that the broadcasting rights cost $15,000, of which 75 percent went to the Madison Square Garden Corporation and 25 percent to the Sesquicentennial Exposition.

Why was this expense warranted?

Why should a typewriter manufacturer send a word picture of a prize fight to radio fans who did not contribute a cent to the undertaking?

The answer was, "Advertising, goodwill, publicity."

Previous to the announcement that the fight would be put on the air it was rumored that Tex Rickard, the fight promoter would not permit a blow by blow description, or even a round by round telegraphic report to be released into space. Broadcast listeners throughout the nation were clamoring to hear the fight direct from the ringside. Whoever could persuade Tex Rickard to sanction microphones at the arena would be truly a friend of the millions sitting around the invisible ringside. When everything looked dark for the radio fans the announcement was made in the newspapers that the typewriter company had pulled the chestnuts out of the fire. The name of the company was on the lips of millions from coast to coast with extremely favorable comment for several days previous to the clang of the gong, which opened the battle in Philadelphia. Then, intermingled with the rounds and the lulls in the battle came the words, "Royal Typewriter," blazened through the ether lanes as a public benefactor, and carried into millions of homes on one of the largest varieties of wavelengths that ever wafted a single radio performance across America.

Some people may say, "Yes, suppose it cost $30,000 or more, just think how much advertising space could be purchased in newspapers and magazines for that sum. Do you think that such an expenditure on the radio pays?"

Then the publicity expert may reply, "I agree that it seems like a lot of money to spend in one night, but it would not buy many pages in magazines that have a large national circulation. Further-

He Pays Approximately $9,000 a Week for Broadcasting

At the present time the "Atwater Kent Hour," which is broadcast every Sunday evening over a chain of fifteen stations, is probably radio's most costly regular feature. The head of the company that pays this huge bill is Mr. A. Atwater Kent of Philadelphia—who believes that the good will of the radio audience is worth at least that much.

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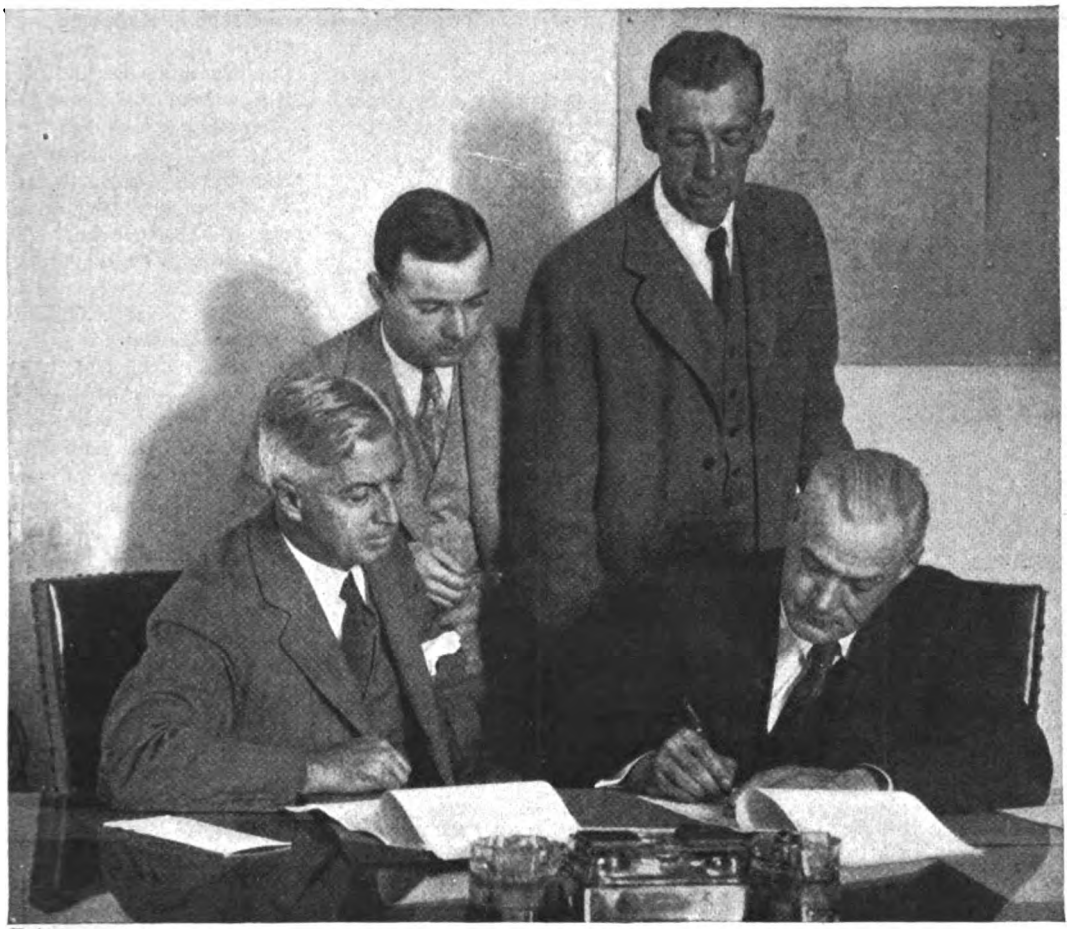

Herbert

A Contract that Cost $35,000 to Entertain the Radio Audience for Three Hours

When Mr. George E. Smith, the president of the Royal Typewriter Company, signed up the rights to broadcast the Dempsey-Tunney fight, he did so because he had faith that enough of the 15,000,000 broadcast listeners would be made favorably disposed to his product to convert this expenditure into an investment.

more, one never knows who will read the printed advertisements. But when your name is broadcast with an event to which you know millions will tune in, you know that it is getting across, especially when it is mentioned time after time throughout the evening.

"You may see a crowd on Broadway watching an attractive electric sign, but that is only a small audience compared to the millions assembled around loudspeakers to hear your name mentioned with an event multitudes are most anxious to hear. They strain their ears to catch every word. The Dempsey-Tunney fight in reality sugar-coated the advertising in a delicious way as far as the effect was concerned; hundreds of thousands of people heard of this particular brand of typewriter in New England, Canada, the Mississippi Valley and on the other side of the Rockies, who may have never known of the machine previous to the fight. Now they are aware that there is one typewriter named "Royal,"—and they learned it through a pleasing circumstance. That creates good-will. It is advertising."

But the experienced etherial advertiser warns that the bread cast upon the infinite expanse of radio space does not return, but is soon forgotten unless it is followed up by newspaper, magazine and billboard displays. Otherwise the radio auditor only knows the name of the product. Names are easily forgotten. It takes the periodical advertising to introduce the product more fully, explain its advantages and help to sell it.

Advertising through the ether lanes has been in vogue for about four years on a commercial scale, but the championship fight opened the eyes and minds of many business houses to inquire into the possibilities and results.

The backbone and background of broadcasting today is goodwill. There is method in the madness of the thousands of entertainers who actuate the microphone today. They are all advertisers or publicity seekers. They have something to sell to the radio audience. They want to attract listeners to their shops, or they are desirious of making their name, or the name of their product a household word. There are few philanthropists behind the microphone. Few broadcast today for the novelty of having their friends hear their voices over the air; those days are past. Today broadcasting is a highly competitive business, with solicitors in the field searching for advertisers to sponsor programs. Remember when you are listening-in that no matter how sweet the music, or how famous the artist, the announcer is generally standing alongside distributing advertising figurative leaflets, which he spasmodically sprinkles through space on the wings of the song.

Last year several advertisers sponsored concerts by noted opera singers and symphony orchestras, as a means of acquainting the public with the name of their products. They are sponsoring more programs this season and have attached their name to concerts by Metropolitan Opera stars and even the Boston Symphony Orchestra. These broadcasts attract wide attention but apparently not on the vast scale that the fight did, because it appealed to a mass audience that included nearly everyone.

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Radio is a medium which gets right into the home. However, the advertiser over the air must be careful and polite in making his entrance; he must make his bow courteously at the dials just as a salesman would at the door, and if his offering through the microphone is acceptable he will be welcomed into the household.

Today there are many advertisers in the ether who never ask for applause in the form of mail. Any letters that they receive are not used for solicitation of business. Those days are over, according to the etherial impresarios. Today the main object is to create good-will, and constant pleading for applause does not build up good-will.

A tooth paste manufacturer recently offered a booklet over the air, and to all who sent in a request he also mailed a sample of tooth paste to acquaint the public with his product. This procedure is sanctioned by the radio impresarios.

Another well-known tooth paste manufacturer, who does not broadcast, recently went through his test territory to determine whether or not his product was still the favorite. He found that a competitor, who sponsors a popular

Program Feature	Sponsor	Stations
Atwater Kent Hour	Atwater Kent Mfg. Co.	WEAF, WEEI, WGR, WRC, WWJ, WSAI, WGN, WCCO, WJAR, KSD, WTAG, WCAE, WTAM, WOC, WFI
Auction Bridge Hour	U. S. Playing Card Company	WEAF, WEEI, WGR, WRC, WWJ, WSAI, WGN, WCCO, WJAR, KSD, WTAG, WCAE, WTAM, WOC, WFI, WCSH
A & P Gypsies	The Great Atlantic & Pacific Tea Company	WEAF, WEEI, WJAR, WLIT, WRC, WDAF, WCSH, WCAE, WTAM, WWJ, WSAI
Balkite Hour	Fansteel Products, Inc.	WEAF, WEEI, WGR, WWJ, WTAM, WFI, WSAI, WGN, KSD, WOC, WDAF, WCAE, WCCO
Champion Sparkers	Champion Spark Plug Co.	WJZ, WBZ, KDKA, KYW
Dairy Products Hour	National Dairy Products Co.	WJZ, WBZ, KDKA, KYW
Davis Saxophone Octette	Davis Baking Powder Co.	WEAF, WEEI, WJAR, WLIT, WRC, WTAG, WCAE, WGR, WSAI, WCSH
Dennisoncraft	Dennison Mfg. Company	WEAF, WEEI, WLIT, WRC
Clicquot Club Eskimos	Clicquot Club Company	WEAF, WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI, WTAM, WWJ, WSAI
Eveready Hour	National Carbon Company	WEAF, WEEI, WJAR, WTAG, WGR, WFI, WRC, WCAE, WTAM, WWJ, WGN, KSD, WSAI, WCCO, WOC
Goodrich Zippers	Goodrich Tire Company	WEAF, WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WSAI, WADC, WCAE
Hohner Harmony Four	M. Hohner, Inc.	WEAF, WEEI, WLIT, WGR, WRC, WCAE, WWJ, WLIB, WTAM
Ipana Troubadours	Bristol & Myers	WEAF, WEEI, WGR, WRC, WCAE, WWJ, WLIT, KSD, WCCO, WSAI
Jolly Buckeye Bakers	Burger Brothers	WEAF, WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG, WLIB
La France Orchestra	La France Mfg. Co.	WEAF, WEEI, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ, KSD
Maxwell Coffee Hour	Cheek Neal Company	WJZ, KYW, WBZ, KDKA
Royal Typewriter Hour	Royal Typewriter Co.	WJZ, WBZ, KDKA, KYW
Schickerling Crystal Gazers	Schickerling Mfg. Co.	WEAF, WEEI, WGR, WFI, WCAE, WWJ
Sixty White Minutes	E. A. White Organization	WJZ, WBZ, KDKA, KYW
Smith Brothers	Smith Bros., Inc.	WEAF, WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO, WDAF
The Vikings	Scott & Brown	WEAF, WEEI, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO, WOC
The Watchmakers	Dueber Hampden Watch Co.	WJZ, WBZ, KDKA, KYW
Tower Health Exercises	Metropolitan Life Insurance Co.	WEAF, WEEI, WGR, WRC
Whittall Anglo-Persians	Whittall Associates	WEAF, WEEI, WGR, WTAG, WJAR, WCCO, WLIT, WRC, WOC, WCAE, WTAM, WDAF, WWJ, KSD, WGN
Willys-Overland Hour	Willys-Overland Co.	WJZ, WBZ, KDKA, KYW

Some of the outstanding program features that are broadcast from a chain of stations.

Nearly every owner of a receiving set has tuned in on at least some of the programs tabulated above. The sponsors of these program features and the toll stations to which they pay toll charges are listed above. What the toll charges amount to may be computed from the rate-card on page 94.

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dance orchestra over a chain of stations, had forged ahead and captured the leadership in sales.

A razor manufacturer during his first year on the air is said to have received 75,000 letters; to many of those who commented upon the programs he mailed a small safety razor. This is reported to have greatly stimulated the sale of blades for that particular razor.

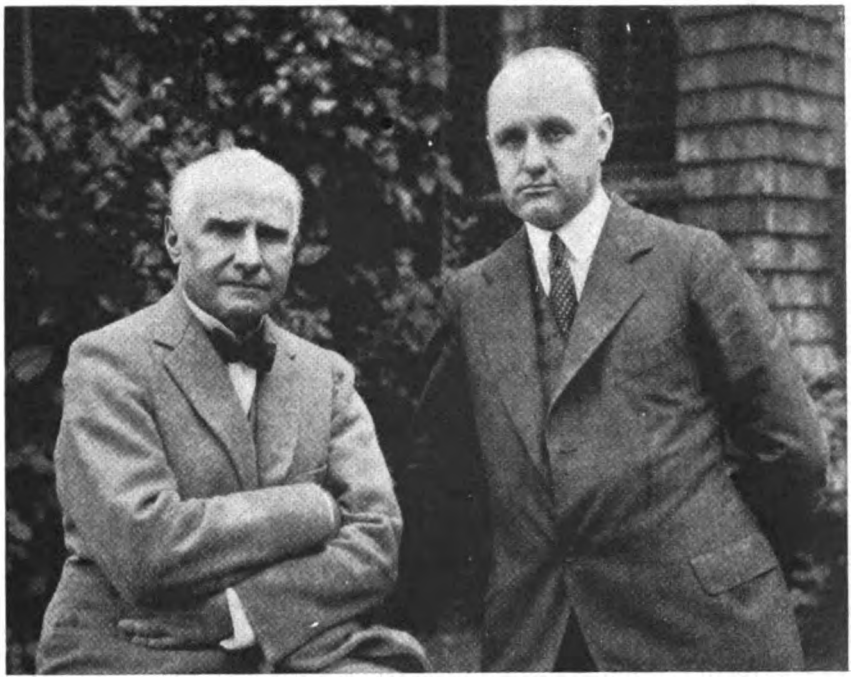
When asked what benefits an insurance company derived from radiating setting-up exercises a broadcast station official replied, "Health and longer life. Such broadcasting is very popular and thousands of dollars are spent yearly in sponsoring the early morning gym class. The physical director receives from 200 to 300 letters daily requesting the chart which illustrates the various exercises which he directs in front of the microphone. He has received more than 200,000 requests for charts. And not one name has been used for soliciting insurance."

An insurance company in the West built a broadcasting station and many wondered what motive prompted the undertaking and what benefit could be obtained from the expenditure. However, there was method in the "madness." Each insurance solicitor of this company has the call letters of the station on his business card. The solicitor travels in the farm sections and when he sees an antenna strung across the roof of the homestead or barn, he goes to the door and presents his card with the additional introduction, "I am from station ZYX." All the farmers are familiar with the station and are appreciative of the entertainment and market reports; in fact they consider the station their friend and the station's representative likewise. He is invited into the home and they talk about radio. Perhaps the station is on the air at the time the solicitor calls and the farmer says, "Come right in and hear your station. Just listen how loud we get it."

The farmer is glad to talk about radio and the benefits he derives from tuning-in. Then the conversation drifts to insurance. The farmer shows the salesman around his farm and the city man in return invites the rural resident to visit the broadcasting studio to see the "wheels go 'round." In this way contacts are made, and it is reported that a big increase in insurance business has resulted among the farmers out where the corn grows tallest.

How does the advertiser know that he is getting results on the radio?

He has several ways to check up the results. First, by the amount of mail he receives. One broadcaster asked the radio fans to comment upon the programs, and the mail that resulted filled filing case after filing case with letters.



The Donor of a Series of $4,000 Concerts

Every time the New York Symphony Orchestra under Walter Damrosch (at the left) gives a special recital before the microphone in the series of concerts arranged by the Fansteel Products, Inc., Mr. A. J. Troxel, the president of that concern (at the right) okeys a check for the music alone that amounts to 2.64 times the yearly income of the average family in the U. S.

Another means of checking up on the radio is the reaction on the dealers. Salesmen find out if business has been stimulated because of broadcast programs. One advertiser who sold winter footwear sold his entire product by December, and broadcasting was given credit for helping to create the big demand; one dealer in Providence wired either to send ten cases of footwear immediately, or stop broadcasting, because he was swamped with orders.

Many manufacturers who sponsor radio programs find that their programs make it much easier to get high class dealers and distributors. This is said to be especially true in the automobile tire and accessory field. The dealers report that the good-will broadcasts attract customers to the stores. Some people come for applause cards or booklets that are offered over the air; others buy because they have enjoyed the concerts. Thus the broadcasts stimulate patronage and dealers are anxious to handle the wares of manufacturers who promote broadcasts.

A harmonica manufacturer engaged the microphone of a New York station with harmonica music and offered an instruction booklet on how to play the mouth-organ. Thousands wrote for the booklet and the New York harmonica market was sold out. No one could listen to the lessons on the radio and at the same time learn to play without a harmonica, and naturally they bought the product of the firm that supported the program, because they wanted to have the proper instrument.

Auction bridge games that are broadcast with the object of teaching radio auditors to play the game, have attracted much attention among the invisible audience and resulted in the sale of thousands of packs of cards. This season the bridge games have been resumed on a weekly schedule instead of bi-weekly and a larger chain of stations is being used.

It has been found that different types of programs are more suited to be associated with certain products. The name "Happiness Boys" is synonymous to the name of the product they promote, as were Goldy and Dusty closely related to their cleanser. In the Eskimo Ensemble which entertains on Thursday nights with bright and sparkling music, the banjo is made to predominate because it creates a suggestion of the sparkling in the ginger ale which the particular troupe of Arctic residents represent.

What does a moving picture theatre gain from broadcasting? The Hertzian waves are employed to popularize the name of the show house and during the entertainment the theatrical program of the week is mentioned so that the public will be aware of the performance and who is acting on the screen.

(*Continued on page 94*)

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From a photograph made for POPULAR RADIO

THE DESIGNER TUNES IN ON THE COMPLETED MODEL

FIGURE 1: *After the final model had been built it was given a complete check-over both by Mr. Harkness and the technical staff in the* POPULAR RADIO LABORATORY *under all kinds of conditions, in order to determine its relative values of selectivity, tone quality and volume.*

HOW TO BUILD THE NEW

KH-27 RECEIVER

This new receiver features an entirely new type of audio-frequency amplification—the Hiler double-impedance system. It has been designed to attain the best possible tone quality as well as to meet high requirements for volume and selectivity.

By KENNETH HARKNESS

COST OF PARTS: *Not more than $86.50*

HERE ARE THE PARTS THAT WERE USED IN THE LABORATORY MODEL—

A1, A2 and A3—K-H radio-frequency transformers, comprising one antenna coupler, one second-stage coupler and one detector coupler;
B1, B2 and B3—Hammarlund midline, 17-plate condensers, .00035 mfd.;
C1 and C2—X-L vario-densers, type G, .0001 mfd. maximum;
D1, D2 and D3—K-H Twin-Choke audio couplers;
E—K-H choke coil, 30 henries;
F—Any approved fixed condenser, .00025 mfd., with grid-leak mounting (Micamold condenser illustrated);
G—Any approved fixed condenser, .001 mfd. (Micamold condenser illustrated);
H and I—Any approved fixed condenser, .002 mfd. (Micamold condensers illustrated);
J and K—Any approved bypass condenser, 1 mfd. (Dubilier condensers illustrated);
L—Any approved grid-leak, 3 megohms (Micamold grid-leak illustrated), with grid-leak mounting;
M—Yaxley fixed resistance, 2 ohms;
N—Any approved rheostat, 10 ohms (Yaxley rheostat illustrated);
O1, O2 and O3—Any approved automatic filament control for ¼-ampere tubes (Amperite control illustrated);
O4—Any approved filament control for ½-ampere tube (Amperite control illustrated);
P—Any approved open-circuit jack, Junior type (Yaxley jack illustrated);
Q—Yaxley pilot light bracket;
R—Yaxley antenna switch, double-circuit Junior type;
S—Any approved battery switch (Yaxley switch illustrated);
T1, T2, T3, T4, T5 and T6—Any approved vacuum-tube socket (if prepared panel is obtained these are not needed)
U—Composition panel, drilled and engraved, 7 inches by 26 inches;
V—Sub-panel, drilled and equipped with sockets, 7 inches by 25 inches;
W1 and W2—K-H bakelite brackets;
X—Any approved cabinet for 7 by 26-inch panel (Blandin R-20 cabinet illustrated);
Y1, Y2, Y3, Y4, Y5, Y6, Y7, Y8, Y9, Y10 and Y11—Any approved binding post (Eby binding posts illustrated);
Z1 and Z2—Any approved vernier dial (Aristocrat vernier port dials illustrated);
One 6-volt lamp for pilot light;
One set of POPULAR RADIO "KH-27" blueprints;
24 6/32 round-head brass machine screws, ½-inch long, and nuts;
12 6/32 round-head brass machine screws, ¾-inch long, and nuts;
24 soldering lugs;
Bus bar, etc.

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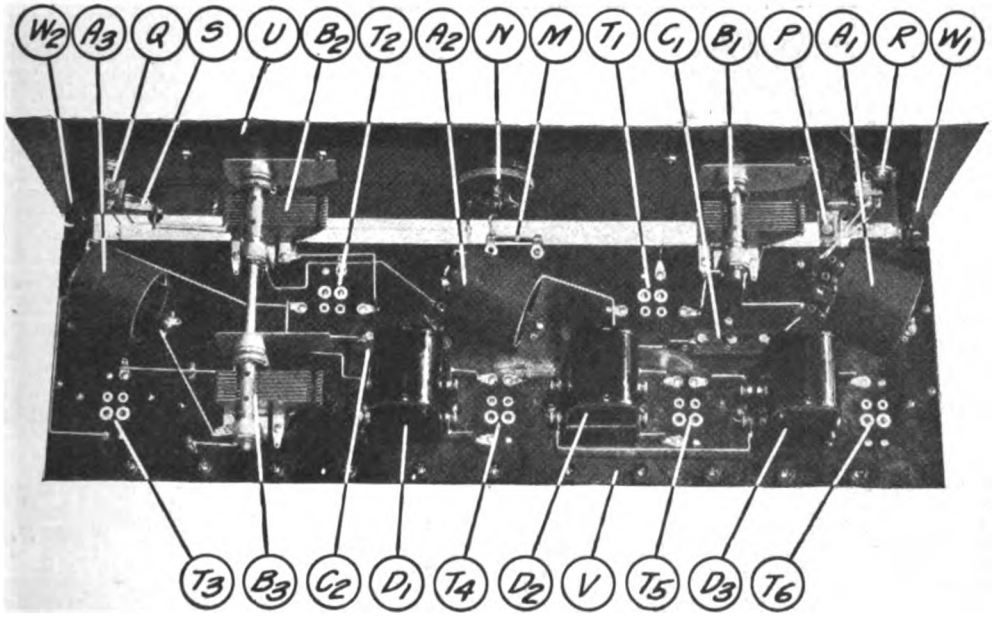


A VIEW OF THE SET FROM ABOVE

FIGURE 2: *This view shows the general arrangement of all the instruments that are mounted on the panel or on the top side of the bakelite baseboard. Notice that the binding posts are mounted along the rear edge of the baseboard; the sockets in this case are rivetted directly to the baseboard itself.*

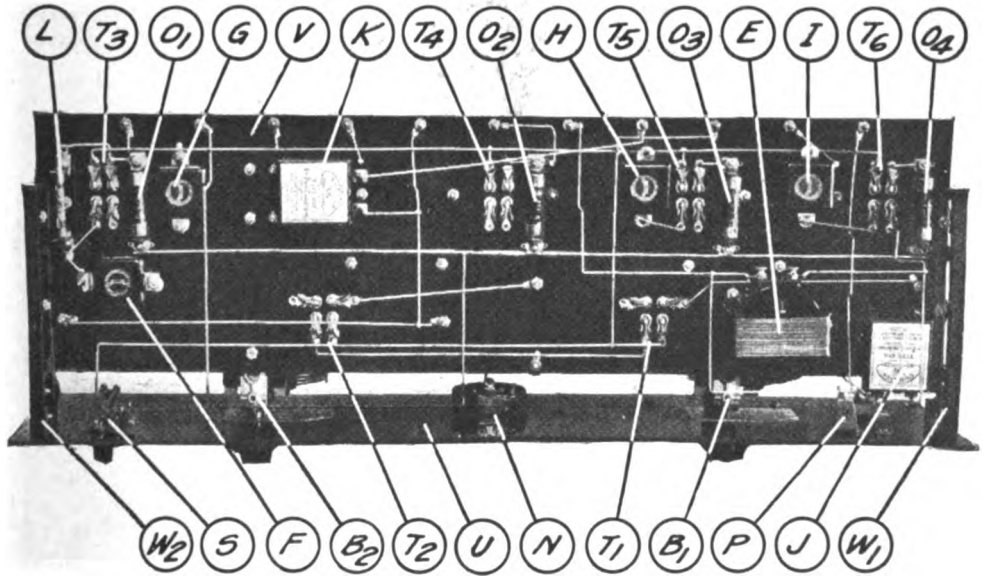
THE KH-27 is the result of a long series of experiments conducted by the writer during the summer of 1926. The primary object of these experiments was the development of a receiver with perfect tone quality; all other characteristics were made subservient. However, in so doing, nothing was omitted of the essential characteristics of a good receiving set.

In addition, therefore, to its remarkable tone quality the KH-27 has the following desirable features:

1. It is an exceptionally good "distance-getter."
2. The selectivity is adequate for all purposes; even in districts surrounded by broadcasting stations the set will receive any desired station without interference from other stations.
3. The set is easy to operate; only two tuning dials are used.
4. It is entirely non-regenerative as it is neutralized to prevent oscillation. The set does not whistle or squeal and it cannot radiate.
5. Any type of outdoor or indoor antenna may be used with it; local stations can be received without any antenna if desired.
6. The set will operate with ordinary "A" and "B" batteries or on the house current by the use of power-packs.
7. Standard parts, easily obtainable, are used in the construction of the set.

The front and sub-panels are of standard size and any desired type of cabinet may be purchased to accommodate the set.

The set is easy to build and once it is installed will give consistently good performance without any special care or attention.



HOW THE RECEIVER APPEARS WHEN VIEWED FROM BELOW

FIGURE 3: *The apparatus mounted underneath the bakelite baseboard is shown here as well as the general appearance of the wiring. The baseboard is fastened to the panel by means of bakelite brackets, shown at each end.*

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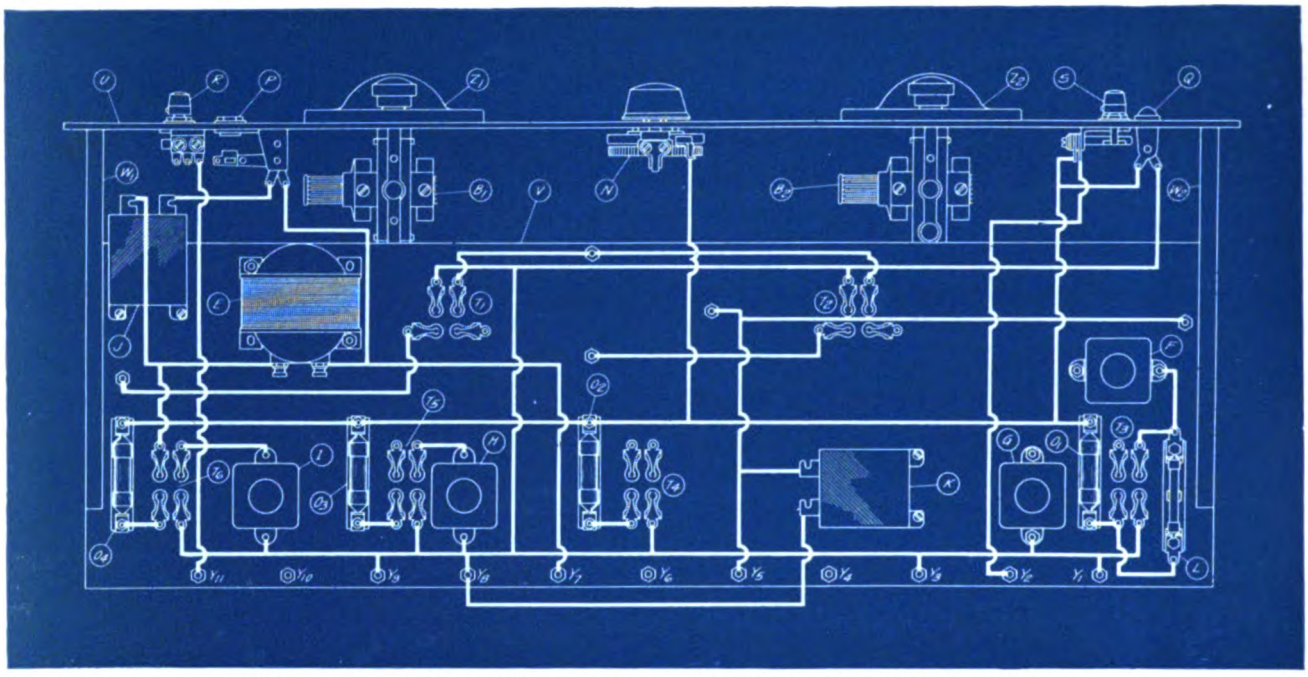
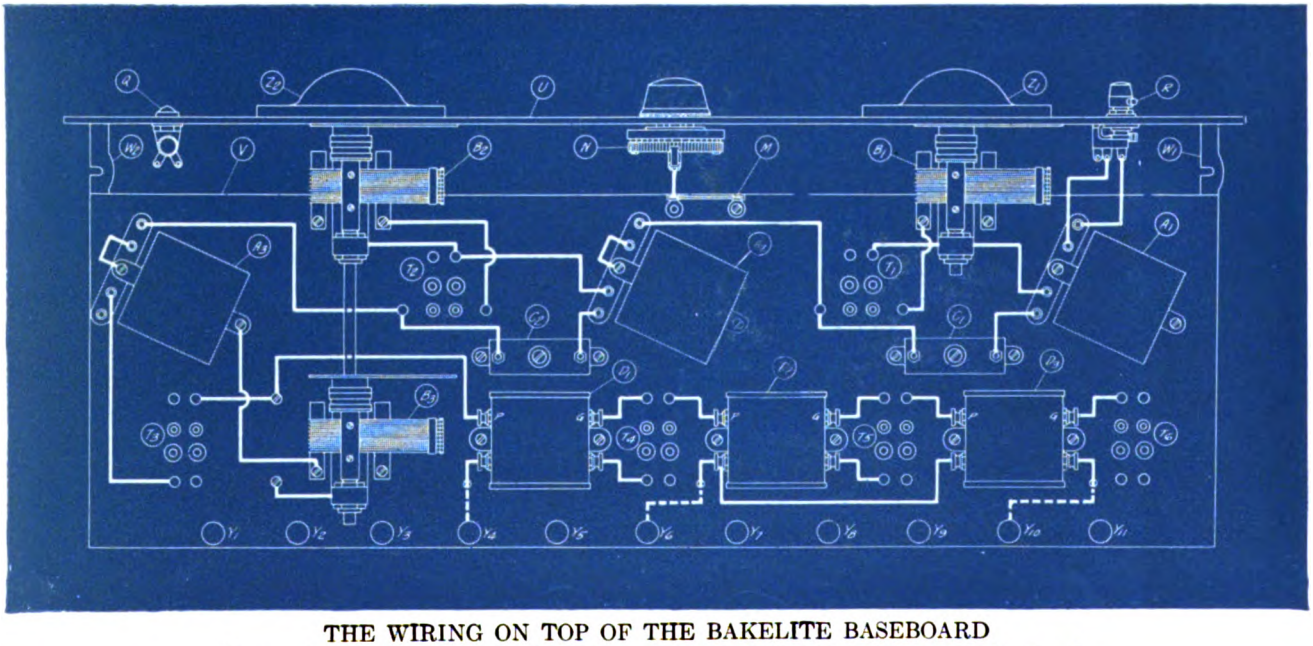


THE PICTURE WIRING DIAGRAM FOR THE BOTTOM SIDE OF THE BAKELITE BASEBOARD

FIGURE 4: *The instruments are drawn in about their correct positions; the heavy white lines show exactly where to run the wires. All the parts are designated by the same letters that appear in the text and in the list of parts.*

Blue Prints for the KH-27 Receiver

¶ *For the benefit of the experimental set builder who may prefer to assemble the KH-27 Receiver from larger diagrams than can be reproduced within the limited space of these magazine pages, a set of simplified blue prints in actual size has been prepared. This set includes* (1) *the two picture wiring diagrams,* (2) *the panel layout and the sub-panel layout, and* (3) *the schematic circuit diagram, as well as the comple'e list of parts used in the laboratory model. If this set of blue prints cannot be obtained from your dealer, it will be furnished upon receipt of a remittance of $1.00 sent to the* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City.*



THE WIRING ON TOP OF THE BAKELITE BASEBOARD

FIGURE 5: *This drawing shows the positions for the instruments on the top of the baseboard; the heavy white lines again show the wiring. The dotted portions of the wire shown here indicate that the wire runs through a hole in the bakelite baseboard and attaches to an instrument terminal on the lower side.*

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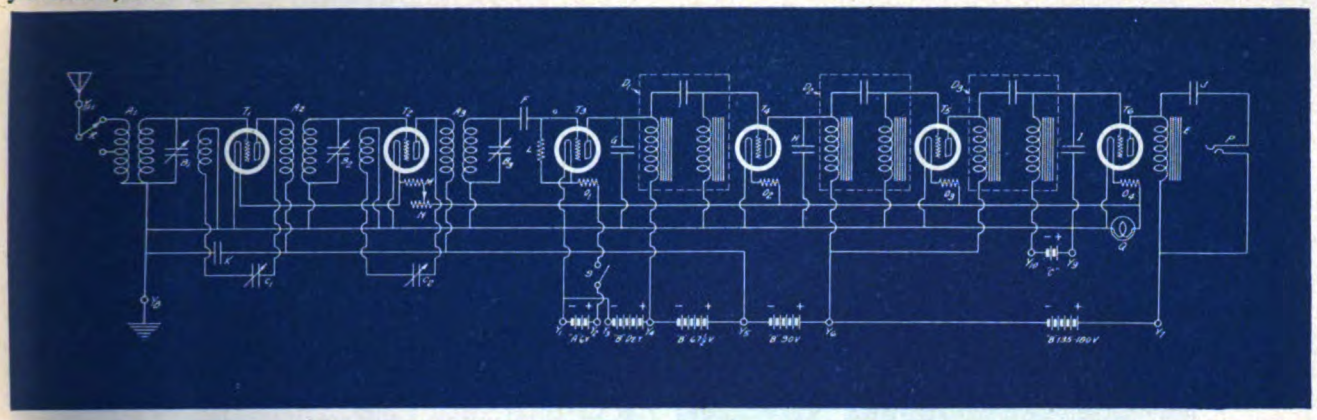
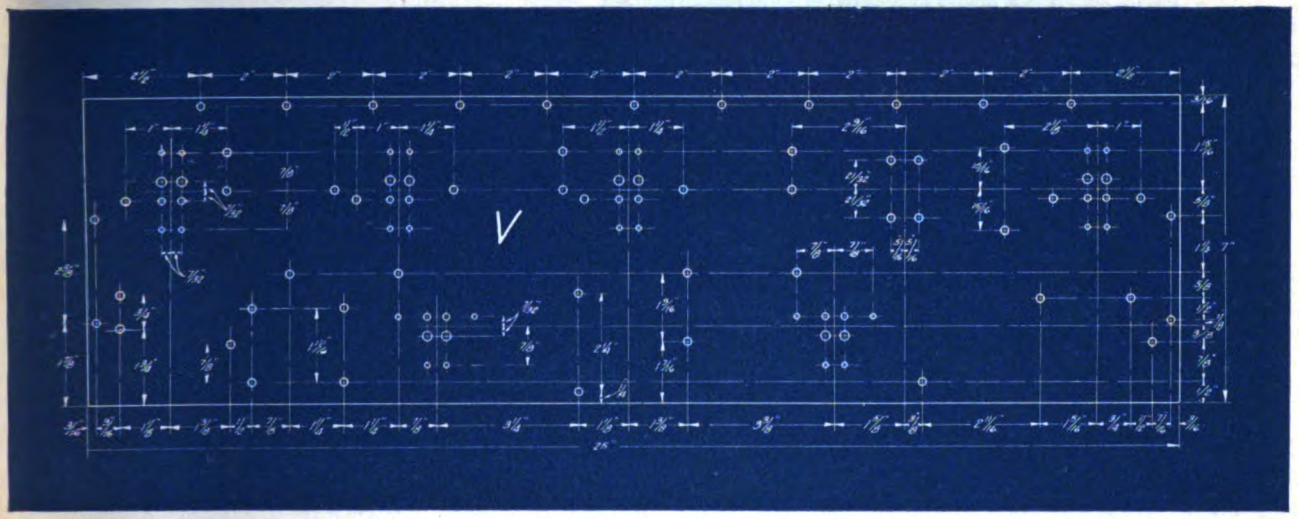


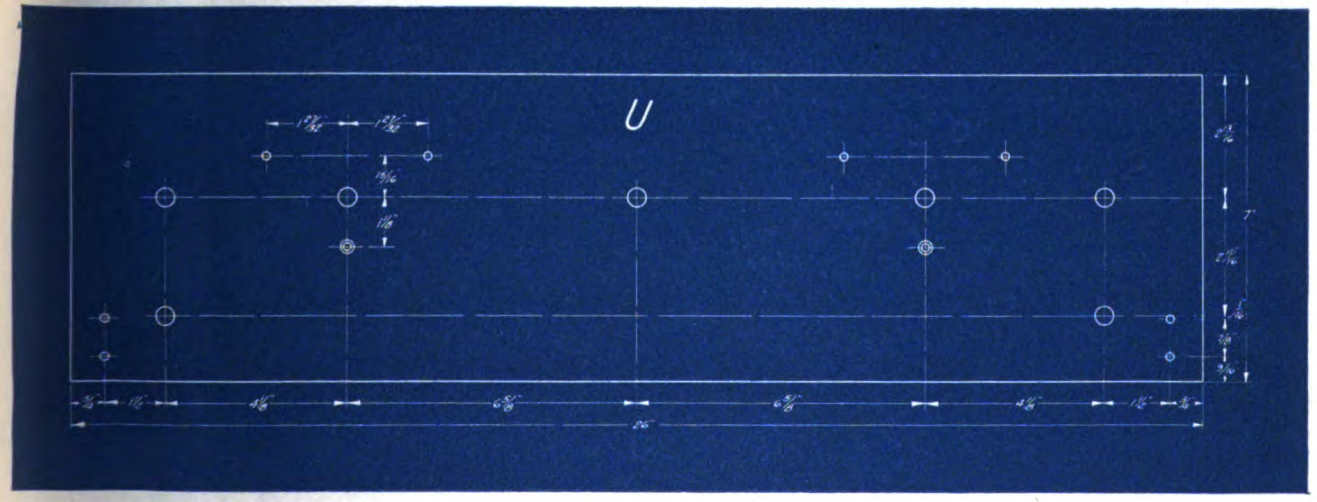
THE SCHEMATIC CIRCUIT DIAGRAM

FIGURE 6: *This gives the complete hook-up at a glance. Notice that two stages of radio-frequency amplification neutralized by an easily balanced method, a vacuum-tube detector and three stages of the new double-impedance amplification are used as well as an output filter for the last tube and loudspeaker.*



HOW TO DRILL THE BAKELITE BASEBOARD

FIGURE 7: *The exact positions for the holes that must be drilled in order to mount the instruments on the bakelite baseboard (or sub-panel) are given in this drawing. If another type of socket is used the drilled holes that correspond will have to be altered to fit.*



HOW TO DRILL THE FRONT PANEL

FIGURE 8: *This drawing shows the exact positions of the holes for the instruments that are mounted directly on the front panel and for the screws that hold the brackets. The sizes for the holes will have to be determined by examining and measuring the instrument shafts or the screws that are to fit in the holes.*

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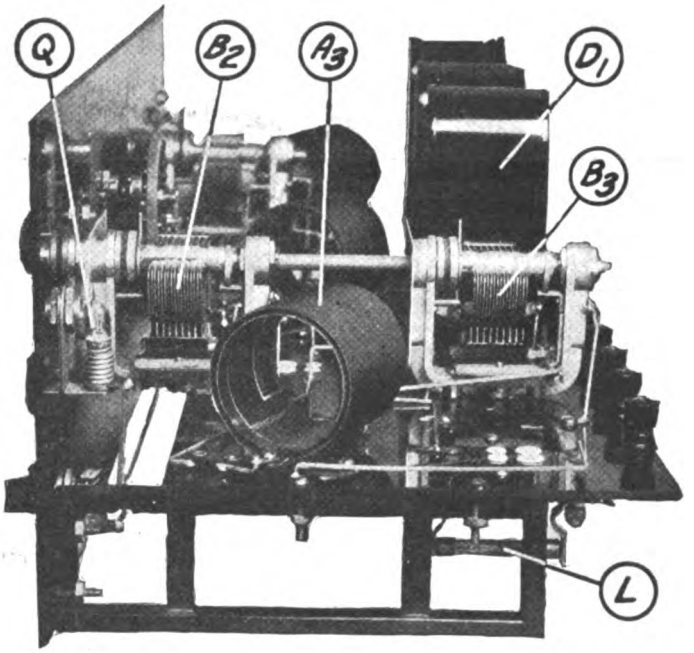
The list of parts given on page 16 includes the exact instruments used in the unit from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by POPULAR RADIO *which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*



THE RECEIVER AS SEEN FROM THE RIGHT

FIGURE 9: *This end view of the set gives a general idea of how the brackets and the bakelite baseboard are attached to one another and to the panel, and also how the coil and the gang condensers are mounted.*

The KH-27 should satisfy all the cravings of the DX fans. The set has two stages of radio-frequency amplification and each stage gives a good solid boost to an incoming signal from the broadcasting station.

The radio-frequency transformers are unusually efficient. They are space-wound on an extremely thin film of dielectric material and losses are almost too low to be measured. The primary of each transformer is wound with fifteen turns of wire and is closely coupled to the secondary. Consequently, the amplification per stage is very high.

The primary of the first radio-frequency transformer, connected in series with the antenna, is tapped at the eighth turn to permit efficient reception of short waves with the average antenna. A switch on the front panel enables the operator to connect eight or fifteen turns in series with the antenna as desired.

The large primaries of the radio-frequency transformers insure high amplification and good distance reception, but they also have another important effect; they insure good tone quality by preventing side-band distortion in the radio-frequency amplifier. Transformers with small primaries of five or six turns not only give meagre amplification but tune altogether too sharply and thus distort the incoming signals.

Each tuned circuit of the new receiver, considered by itself, tunes broadly enough to respond to frequencies about 12 kilocycles above and below the carrier frequency. To obtain good quality this is essential. But when the three circuits are tuned alike, interfering signals on frequencies outside the spectrum to which the set is adjusted are sifted out by the successive stages and do not reach the detector tube.

Consequently no interference from stations on adjoining wavelengths is experienced. In New York, within half a mile of WEAF and surrounded by about fifty other nearby stations, the set is capable of reproducing any of these stations without interference and can even bring in distant stations while the locals are on the air.

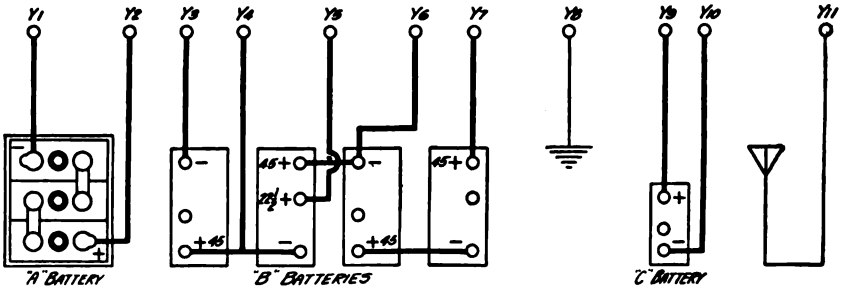
As mentioned above, the set is non-regenerative. Each stage of the radio-frequency amplifier is neutralized to prevent self-oscillation and to eliminate regeneration. The system of neutralization used in the set was developed by the writer and is an improved application of the Rice method. The scheme of connections is depicted in the wiring diagram, Figure 6.

Neutralization is effected by adjusting two, small, variable condensers. The large capacity of each of these condensers (.0001 mfd.) makes it easy to neutralize the set. The coils L1 and L2 are also part of the neutralizing system. These coils are placed inside of the radio-frequency transformers.

Before describing the construction of the set a brief explanation will be given of the special system of audio-frequency amplification used. The system is known as "double-impedance" audio amplification and is the invention of E. E. Hiler. The use of this system is largely responsible for the remarkable tone quality of the KH-27.

The principles underlying the operation of the double-impedance, audio amplifier are easily understood. The amplifier is similar to the standard "impedance-coupled" amplifier except that choke coils are used as grid-leaks instead of the usual high resistances. This difference is responsible for the many important advantages of the system. Practically uniform amplification of all

(*Continued on page 68*)



HOW TO CONNECT THE BATTERIES

FIGURE 10: *The connections for the "A," "B" and "C" batteries and the antenna and ground to the binding posts of the receiver are clearly shown here. Note that these binding posts have been given numbers that correspond with those given in Figure 5.*

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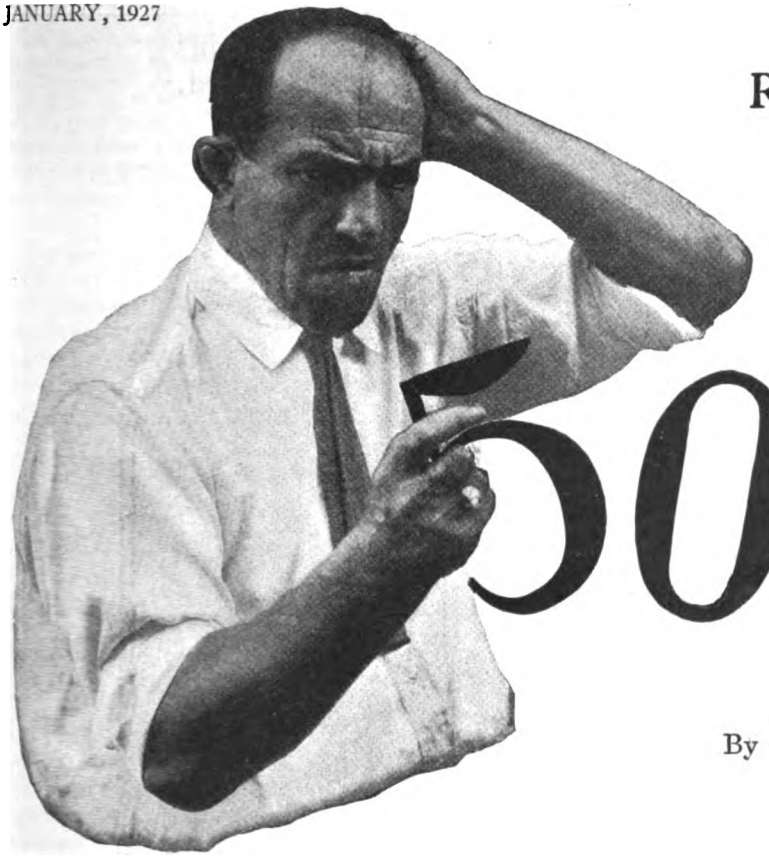

Radio's Contribution to Our Language—

500 *Words*

By CHARLES MAGEE ADAMS

IT has been estimated by philologists that the newest means of communication has added some 500 words to the language—only 100 fewer words than were added by the World War.

What is less generally known, however, is that most of these words—with the exception of the numerous "dynes," "flexes," "olas," and "supers," which have been deliberately coined—were in use by radio men before broadcasting came into existence. But it was not till some time after the advent of broadcasting that the evolution in radio language began.

The small group of early fans took over the vocabulary of the new art from the radio men and preserved its purity with zealous care. They were interested primarily in technicalities, and the sound of bristling technical terms was sweet music to their ears; the sweeter as they were used with absolute correctness.

Radio, however, soon lured to itself a large number of adherents who were not interested in the technicalities, and to whom the nice use of correct terms meant nothing. So, they proceeded to devise an array of short-cuts and terms based on the obvious, till today radio terminology is a jumbled polyglot of incongruities and mistakes which means something to the newcomer, but which tries the soul of the old-timer.

"Wet battery" is one of the most familiar examples.

This term is, of course, applied to the storage battery. It is derived from the fact that this type of battery contains a solution, which, to the newcomer, differentiates it from its brother, the dry cell. But the old-timer points out, with disgust and ample authority, that the term "wet" does not in reality differentiate it at all; that many types of primary batteries, of which the dry cell is one, also contain a solution, and that if a storage battery is meant the term "storage battery" ought to be used.

To the newcomer the expression "I just bought six new 'A' batteries" is perfectly correct. But the old-timer retorts that what he means is that he bought "Six new cells for an 'A' battery"; then goes on to explain that "cell" is an individual, and "battery" a collective term, citing the military use of battery as against gun.

Another expression that makes the old-timer gnash his teeth is "lights"—a usage again based on the obvious, this time the resemblance of many types of tubes to incandescent lamps. And "ear-phones"—

The old-timer will explain that the word "phones" necessarily implies ears, and that, accordingly, to say "ear-phones" is as senseless as "foot-shoe," "neck-collar," or "hand-glove."

Who ever heard a listener who has joined the ranks of radio during the last two or three years say "antennae"? The old-timer will inform you with reams of authority, that this is the correct term, although it is popularly referred to as the "aerial." Further, it

(*Continued on page 61*)

Do *You* Know the Approved Terms for These Words?

1. Earphones
2. Wet battery
3. Lights
4. Aerial
5. Recharge
6. Handle
7. Box
8. Re-radiating receiver
9. Wheel
10. Wave
11. Acid
12. Horn
13. Controller
14. Station initials
15. Dying out
16. Hand squeal
17. Big tubes
18. Remote broadcasting
19. Sender

KEY

1. Head-phones; 2. Storage battery; 3. Tubes; 4. Antenna; 5. Charge; 6. Knob; 7. Cabinet; 8. Radiating receiver; 9. Dial; 10. Wavelength; 11. Battery solution or electrolyte; 12. Loudspeaker; 13. Rheostat; 14. Call letters; 15. Fading; 16. Body capacity; 17. Power tubes; 18. Remote-control broadcasting; 19. Transmitter.

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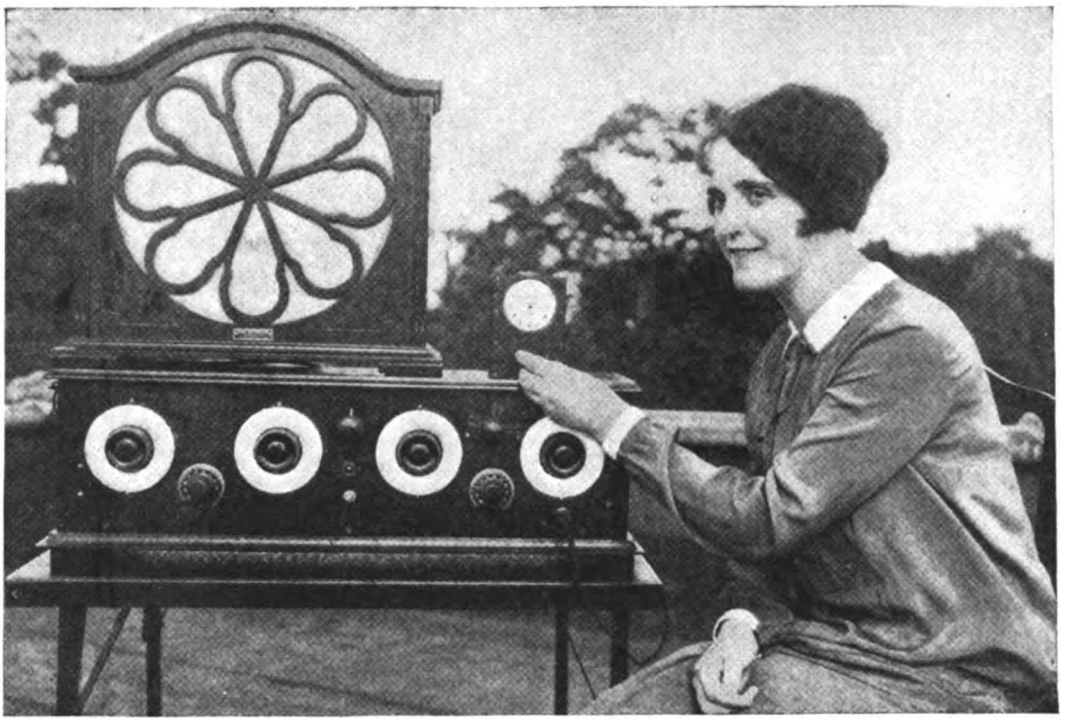
¶ Nearly every fan has at times wished for a device to turn his set on for important programs—or off, after he has gone to bed. Well, here it is!



HOW THE CLOCK IS "SET" TO CONTROL THE RECEIVER

It is connected up to the batteries that feed the receiver, and by a contact of one of the moving parts turns the receiver "on" and "off" at the time to which the clock is regulated.

To Start and Stop Your Set Automatically

—Build the Ingenious Alarm-Clock Control Here Described

By O. D. WESTCOTT

HERE is an ingenious device that has been designed for the special benefit of the broadcast listener who wants to be reminded—automatically and infallibly—to tune in on a special program feature at the specified time.

This apparatus has the merit of being easy and inexpensive to construct at home; any experimenter who has ordinary proficiency with tools can build this "radio control clock." The service that this clock will render to the radio fan is unique and will add materially to the enjoyment that he gets from his receiver. For instance:

Does he want to be reminded to pick up the Arlington time signals at noon? If so, he merely tunes to the wavelength of that station, sets the time-switch to turn the receiver on a few moments before noon—and the signals will come in automatically.

Does he want to pick up a special program feature at 10:00 o'clock in the evening? If so, he just sets the control clock to turn off the receiver at 9:55; at that moment the set will become silent—and he will thus be reminded to tune in on the station he wants to hear.

In like manner the control clock may be adjusted to turn off the set at a specified time after he has gone to bed—or to turn it on in the morning in time to participate in the radio gym class.

Figure 4 shows the schematic diagram of the electrical connections within the control unit; Figure 1, the front view of the "radio control clock"; Figure 3, the rear view, and Figure 2 the side view.

How the Control Clock Works

This is what happens when the alarm goes off.

The wing nut on the end of the alarm wind-shaft turns in the opposite direction to the direction of rotation affected when the alarm is wound up. On this particular type of clock, the "alarm" wing nut is turned in a counter-clockwise direction to wind it up, so that when the alarm goes off this wing nut rotates in a clockwise direction. All that remains to be done, therefore, is to provide a means for translating the motion of the "alarm" wing nut, to a contact so arranged that it will open or close a circuit as desired.

The motion of the wing nut in question is translated to the contact spring, B, shown in Figure 4, through the medium of a contact pin which moves inside of a casing. Whether the downward motion of the contact, B, which always takes place when the alarm goes off, opens or closes a circuit, depends upon the position of a jack switch, which has three contacts numbered 1, 2 and 3.

If it is desired to have the alarm close the circuit at a specified time, the jack switch control knob is pulled out. This closes the circuit between contacts 2 and 3 of the jack switch. Now, as the terminals T_1 and T_2 are connected in series with the filament lead to the receiving set, the receiver is turned off and the filaments of the tubes will not heat up as the circuit through the time switch is open.

A good idea of the state of the circuit at this time may be obtained by tracing

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it through. The circuit runs from T_1 to contact spring B and through the contact between B and A to terminal 1 of the jack-switch. Now, as the jack-switch control knob is pulled out, springs 1 and 2 are not in contact and the filament circuit is open at this point.

Tracing the circuit through from T_2 it will be found that it is open at contact C, one of the terminals of the single-pole, double-throw switch which is formed by the contact spring B and the two contact terminals A and C. The contact spring B engages contact terminal A in its normal position (before the alarm goes off), and engages contact terminal C when the motion of the alarm wing nut is translated into a downward movement of the contact spring B.

Thus when the alarm goes off, contact spring B engages contact C and closes the filament circuit. The filaments of the tubes in the receiving set then heat up to normal temperature and the radio set functions. The circuit through the time switch is now traced, from T_1 to contact spring B to contact C to jack-switch spring 3, to spring 2 and out to terminal T_2.

When the jack-switch is pushed in, the setting off of the alarm and the consequent turning of the wing nut opens the circuit through the time switch and the radio set is turned off. In this case, before the alarm goes off, the terminals T_1 and T_2 are connected in series with the filament lead to the receiving set and the radio set is in operation as the circuit is closed, through the time switch. This circuit may be traced from T_1 to contact spring B to contact A to jack-switch spring 1 and then to spring 2 (as the jack-switch control knob is pushed in causing spring 2 to engage spring 1), and out to terminal T_2.

When the alarm goes off, therefore, contact spring B is pushed downward; this opens the contact between A and B and turns off the radio set.

Now that you understand the theory of operation of this simple little device, you should be better able to go ahead with its construction.

How to Build the Clock

From the rear view of the unit, you can see that the box is divided into two compartments. The clock is in the upper compartment and the motion of the alarm wing nut is translated to the electrical elements which are located in the lower compartment. The electrical elements consist, simply, of two single - pole, double - throw switches (a-b-c) and (1-2-3); the former is operated automatically and the latter is operated by hand.

There are a number of ways of translating the movement of the alarm wing-nut to the contact spring B; one is the contact pin arrangement used in the model described. The construction of this element is probably the only troublesome part of the entire job.

Drill a 1/8-inch hole all the way through a 1/4-inch brass rod, from end to end. Drill a 3/16-inch hole, 1-inch deep, in one end of this rod, and a 3/16-inch hole, 1/2-inch deep in the other end. This last operation leaves a 1/32-inch wall, at each end. If this is too fine work for you use a 3/8-inch rod instead of 1/4-inch.

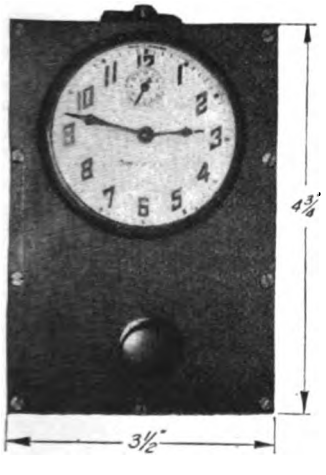
Then, slide a 1/8-inch rod, through the hole in the 1/4-inch rod. If this rod binds at all, it should be cut down 1/64-inch or so with a file, or a piece of emery cloth, until it slips through the hole with a very small amount of friction.

Make a shoulder on the 1/8-inch rod, 3/4-inch from one end. This shoulder should have a diameter, a little less than 3/16-inch, so that it will slide through the 3/16-inch hole, in the 1/4-inch rod. One way of making this shoulder is to solder a washer of the proper size at the point in question. This washer should be a little less than 3/16-inch in diameter and should have a 1/8-inch hole.

Now, slide the 1/8-inch rod into the end of the 1/4-inch rod that has the 3/16-inch hole drilled to a depth of 1/2-inch, inserting the end of the 1/8-inch rod farthest from the shoulder, first. If you push the smaller rod through, as far as it will go, the shoulder will stop it at such a point that it will protrude about 1/2-inch from the end of the 1/4-inch rod, opposite to the end in which it was inserted.

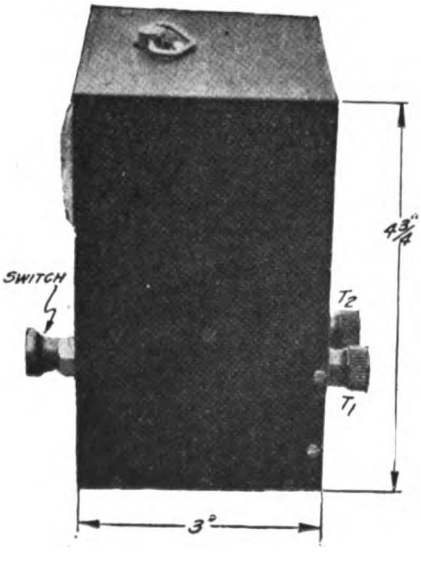
Procure some fine spring wire and make a spring that will slide over the 1/8-inch rod. Slide this spring over the end of the 1/8-inch rod that has no shoulder, as yet, pushing it down be-

(*Continued on page 48*)



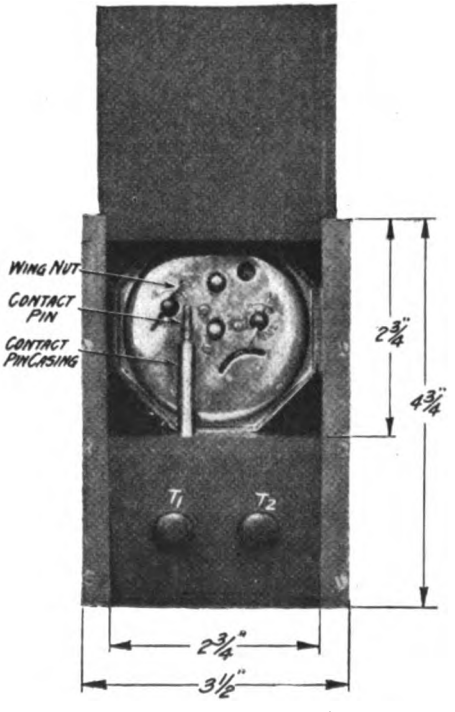
THE FRONT PANEL

FIGURE 1: *This view shows how the clock and switch are mounted on the front panel of the unit.*



THE SIDE VIEW

FIGURE 2: *A rectangular box of compact size houses all of the working parts; it may be made of wood or bakelite.*



THE BACK OF THE UNIT

FIGURE 3: *This picture shows most of the working parts and gives a good idea of how the box that holds them is made.*

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A STATION THAT FOLLOWED ITS MASTER

When James Cruze, the director of this film, moved about the countryside, station KFP moved with him. The set was operated entirely by batteries.

"KFP"

A Miniature Broadcasting Station That Directed a Battle

What really happened on the memorable day when radio hams picked up the sounds of naval warfare between the reel hams

By
LLOYD JACQUET

AN Eastern radio amateur recently tore himself from his short-wave receiver and, reaching for the telephone, announced to the local newspaper editor that "pirates were waging a fierce battle off the coast of California." There was no mistake about it, he said; l e had heard cannon shots, the thunder of heavy boots on decks, wild oaths, the groans of dying men, and commands shouted through the din of clanging cutlasses. . . . .

The ears of the amateur had not deceived him; he had indeed heard all these far-away manifestations of terrific pirate battling.

But what he did not know, was that movie cameras were reeling in the battle as fast as its echoes were wafted across the continent to the alert "hams."

The amateur had been listening in unexpectedly on the first movie production ever directed through the use of radio.

If he had listened a little longer, he would have heard the voice of James Cruze, director, broadcasting his crisp orders of "Action" . . . "Camera!" and "Cut!" to the small army of actors before him.

If he could have viewed the battle he would have seen a dozen or more sailing ships of a type a century old, engaged in a vivid sea-fight on the waters of the Catalina Isthmus. And he would have observed Cruze, seated on the steep shore of California, directing by means of a microphone, one ship to fire, another to veer around into action, and still another to blow itself up and sink.

This spectacular and realistic sea-fight is the climax of a moving picture romance built around the glorious Yankee victory over the Tripolitan pirates in 1804, in which the U.S.S. "Constitution" emerged with the first honors.

A large space was required for the setting, not the least important of which was the fighting scene off the Tripolitan Coast. Dozens of ships, pirate as well as American, dotted the body of water separating the Island of Catalina from the mainland, which figured as the Mediterranean Sea. These small ships had to be brought into action at the right moment, and put through a series of complicated manoeuvers at a time when the noise of the guns and the shouting of the crews would have drowned out the sound of a human voice, even if it had had the strength to carry over such a wide expanse of water.

As the battle-scene extended over a radius of twenty miles, the conventional megaphone direction was out of the question. Even with his powerful voice, Cruze could not hope to make himself heard at the nearest ship nearly a mile away from shore. So the long arm of radio was pressed into service for the first time, as an important auxiliary in photoplay making.

The electrical shops of the film studio turned out, under the direction of its chief engineer, as complete and comprehensive a miniature radio communication net as is owned by any commercial radio company. There was a main station, to be used at the base as the broadcaster; it was built to be entirely portable and self-contained.

This miniature station was operated entirely on batteries; the tube filaments were lit by means of a 12-volt storage battery and the plate voltage was supplied by a large group of heavy "B" batteries, sufficient to give 500 volts. For circuit, the miniature station was wired for the inductively coupled Hartley, and a stage of power amplification was added for the microphone circuit. It was normally rated at 15 watts, so that its range would be comparatively limited to the area of operation. Its wavelength was licensed at 110 meters, and the call letters given it by the Government, with its limited commercial license, were KFP.

Besides this small radio-telephone transmitting outfit, the electricians designed and built about two dozen short-wave receivers and installed them on the units of the wooden fleet, as well as in other strategic positions along the shore. The design was of the conventional short-wave style, familiar to amateurs. As a circuit, the flexible and easily tuned modified Reinartz was decided upon, so that the receiver consisted of a regenerative detector, followed by two stages of audio-frequency amplification. When used with headsets, the voice could be distinguished clearly, even over the maximum local noise.

It was a problem to mount these small receivers on the various vessels, as the rigging did not provide ideal aerial fastenings. Some antennas were but six to eight feet long, while others reached 30 feet. With an experienced operator assigned to each ship, the operation of

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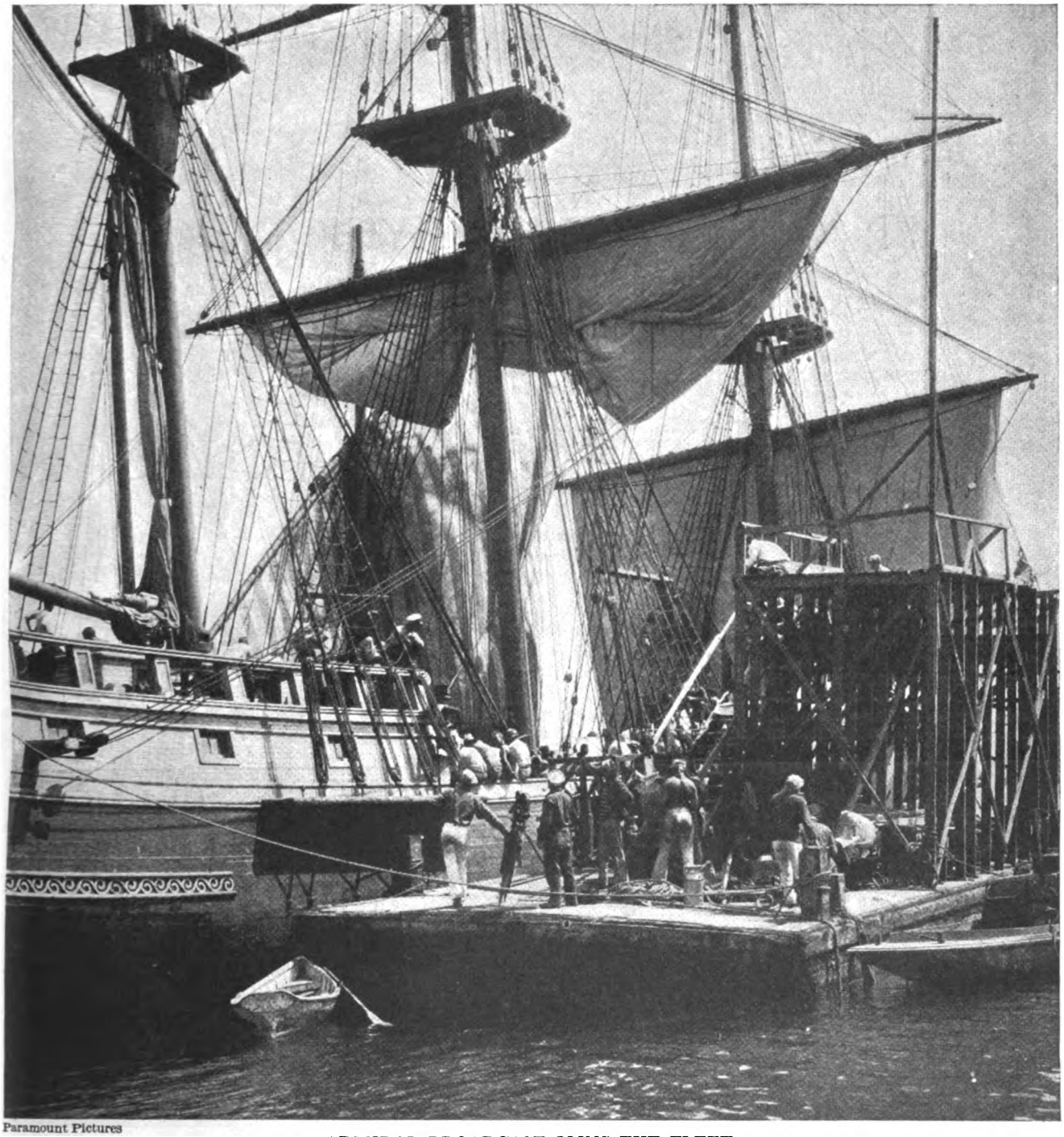
the small receiver and the prompt distribution of orders was assured.

Besides the ships of the movie fleet, tugs and motor boats, docks, headquarters on location, as well as the main office inland were provided with radio sets; thus the director was able to get in touch with every unit of his organization through this up-to-date communication system.

Because of its portability, the radio-telephone transmitter followed the director wherever he went to direct the photoplay. At one time, it would be on a mountain side facing the Tripolitan fort, and then, on top of the barge-platform, a position which permitted the cameramen to get as close as possible to the action.

As the filming progressed, the orders were spoken into the microphone, and were picked up by the units to which they applied. With this novel "radio director," the handling of a small fleet of wooden vessels scattered over an area of twenty square miles and filled with thousands of actors and extras became as easy as studio filming in spite of these seemingly unsurmountable obstacles for the director.

Radio, in the course of its comparatively young career has been called upon to perform many unusual duties, but in this latest application it showed its great adaptability in a dramatic manner.



Paramount Pictures

ADMIRAL BROADCAST JOINS THE FLEET

On the barge in the foreground is located the transmitting apparatus with which the movie director issued commands to the vessels engaged in the mimic battle; the antenna mast may be seen at the right. Receiving sets were installed on each ship, which enabled the different units to co-ordinate their actions with the scene as a whole.

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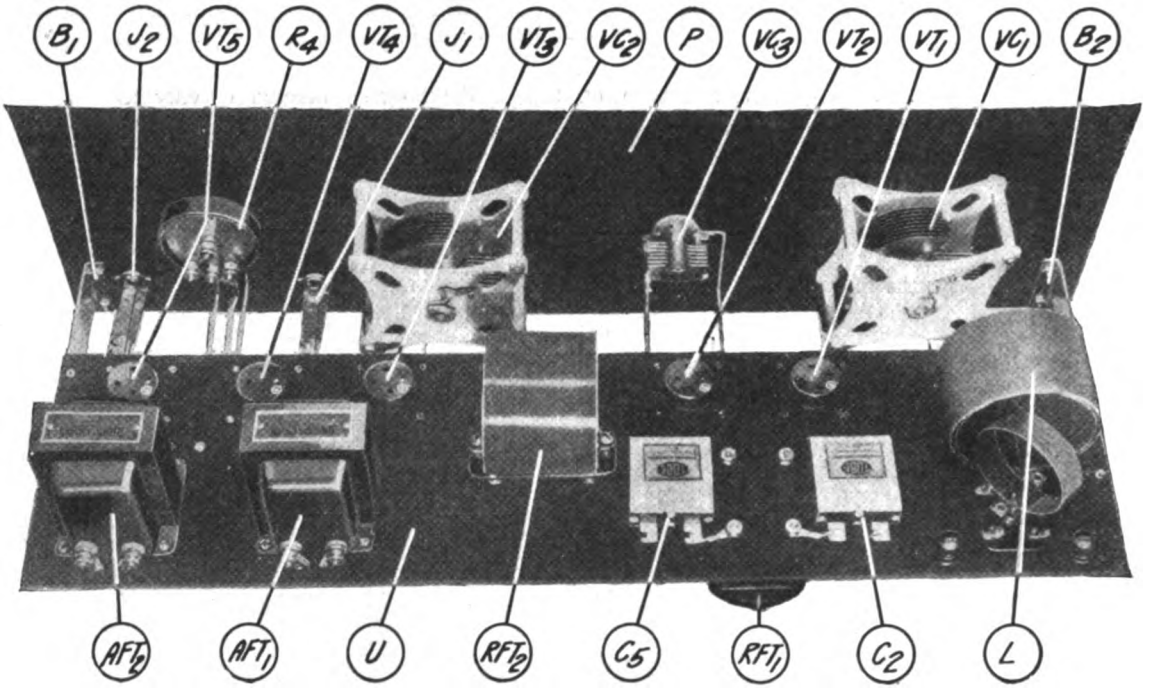


The "Henry-Lyford" Receiver

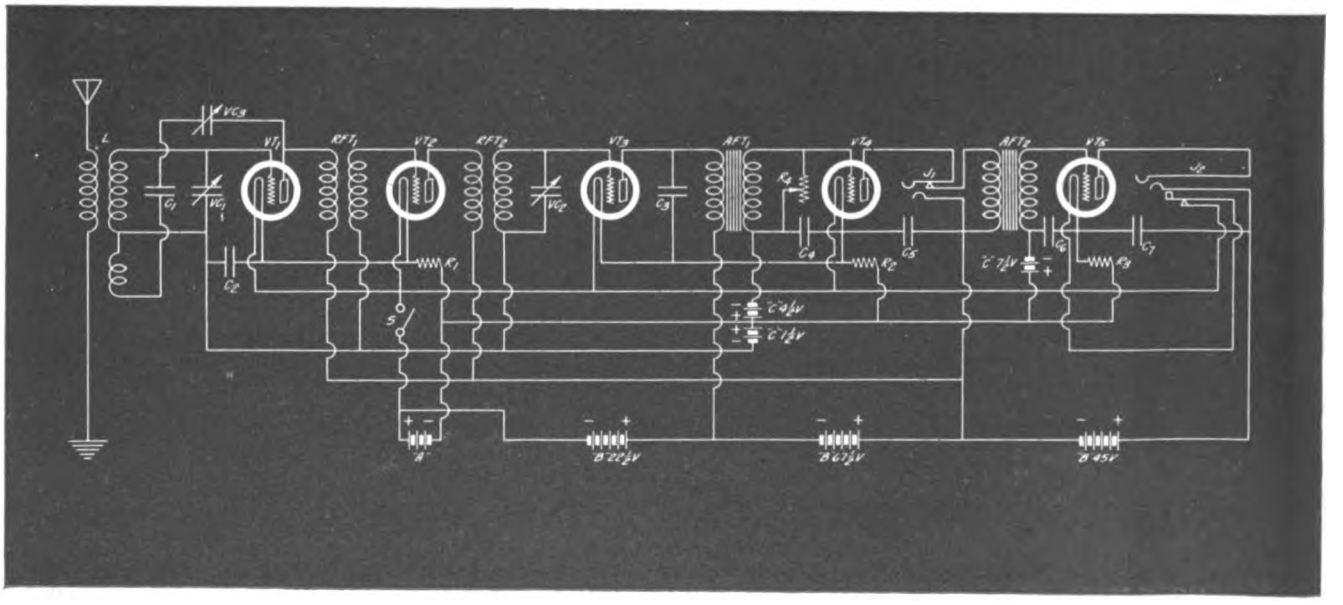
This receiver combines excellent selectivity with fidelity of reproduction; a liberal supply of by-pass condensers affords quietness of operation. Tuning is simplified by utilizing a stage of untuned radio-frequency amplification which employs an iron core transformer. The usual filament-rheostat method of volume control is replaced by a variable, high resistance across the secondary of the first transformer.

Popular Radio Circuits

INSTALLMENT NO. 6

THE PARTS THAT ARE RECOMMENDED FOR USE IN THIS RECEIVER ARE—

L—University antenna coupling transformer, type B-1;
RFT1—University radio-frequency transformer, type B-2;
RFT2—University tuned-radio-frequency transformer, type B-3;
AFT1 and AFT2—Thordarson audio transformers, type R-200;
VT1, VT2, VT3, VT4 and VT5—Benjamin sockets, sub-base mounting type;
VC1 and VC2—Precise variable air condensers, .00035 mfd., type 845;
VC3—Precise variable air condenser, .000055 mfd., type 940;
C1—Micamold fixed condenser, .001 mfd.;
C2, C4, C5, C6 and C7—Tobe fixed condensers, 1 mfd.;
C3—Micamold fixed condenser, .002 mfd.;
R1, R2 and R3—Amperites, type 112;
R4—Centralab modulator, type 500M
S—Yaxley No. 10 filament switch;
J1—Yaxley No. 2-a jack;
J2—Yaxley No. 3 jack;
P—composition panel 7 by 24 inches;
U—composition sub-panel;
B1 and B2—Benjamin brackets;
10 General Radio coil mounting jacks and plugs, type GR274 P-J;
2 Eby binding posts;
2 Kurz-Kash 4-inch dials, range 100 to zero;
Belden 8-wire battery cable.
COST OF PARTS: $69.50.



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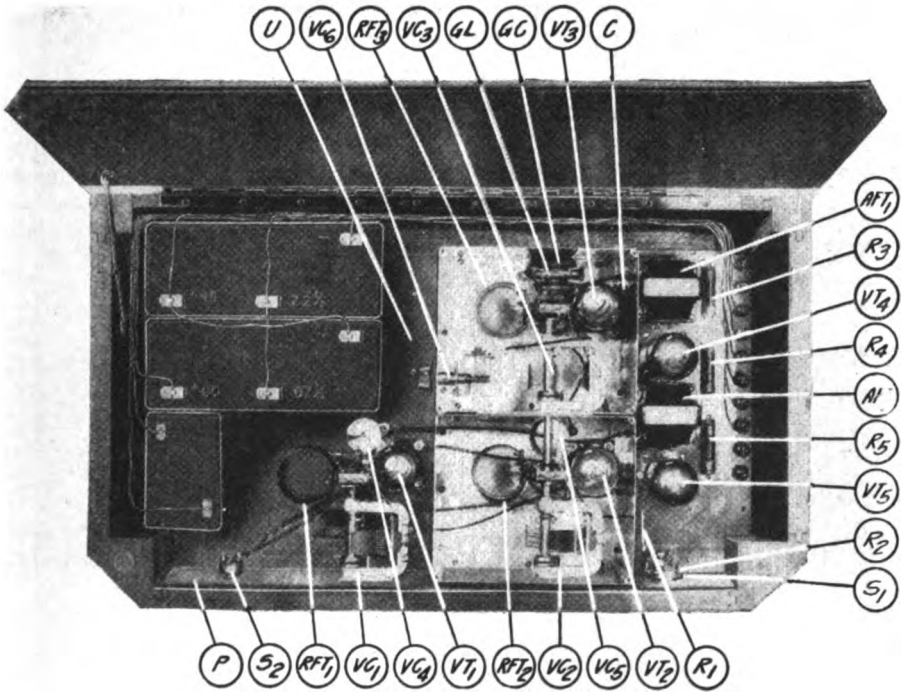
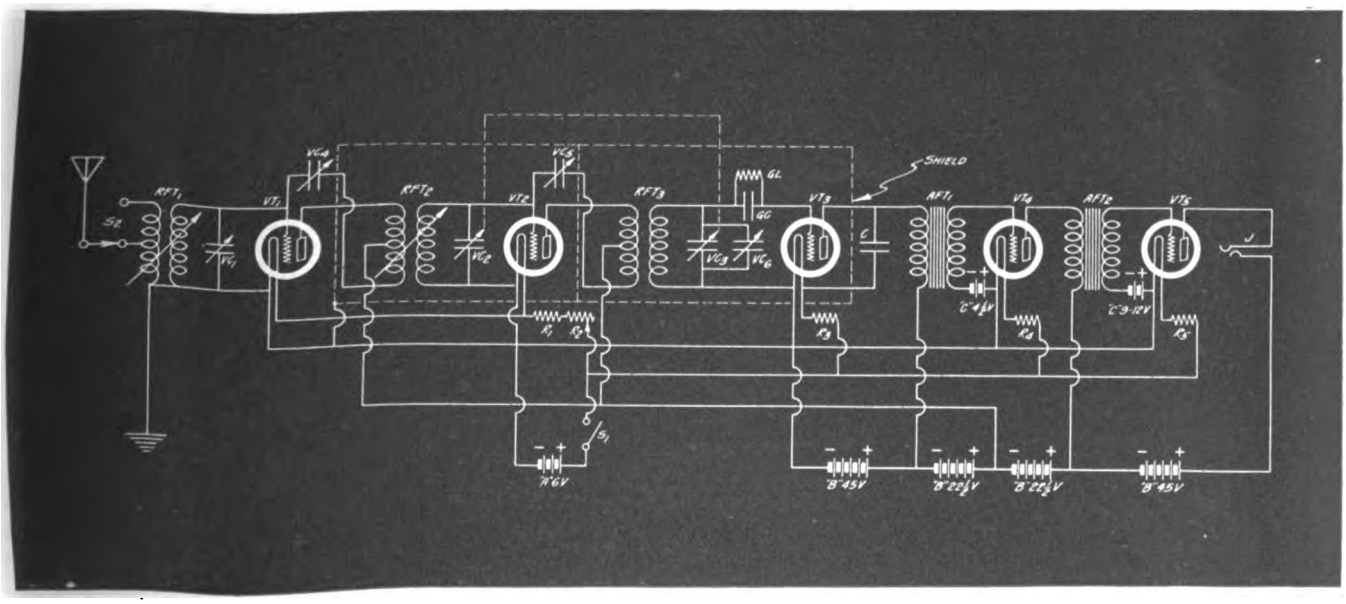


The Hammarlund-Roberts "Hi-Q" Receiver

Here is a fine, shielded receiver that can be built at home, and that combines an excellent radio-frequency amplifier with a high-grade, transformer-coupled audio amplifier. Integral with the tuning condensers is a cam which operates the primary coils of the radio-frequency couplers. These are so regulated that the proper amount of coupling is obtained throughout all broadcast frequencies—a very desirable feature. The last stage of audio-frequency amplification permits the use of a UX-112 type or UX-171 type power tube. The "C" battery shown is for the UX-112 type tube; all other tubes are of the UX-201-a type.

The Parts That Are Recommended for Use in This Receiver Are—

RFT1, RFT2 and RFT3—Hammarlund auto-couple coils;
AFT1 and AFT2—Samson audio transformers, type HWA3, ratio 3 to 1;
VT1, VT2 and VT3—Benjamin sockets, No. 9040;
VT4 and VT5—Benjamin sockets, No. 9049;
VC1, VC2 and VC3—Hammarlund mid-line condensers .00035 mfd.;
VC6—Hammarlund Junior condenser, .000032 mfd. capacity;
C—Sangamo fixed condenser, .001 mfd.;
GC—Sangamo fixed condenser, with grid-leak clips; .00025 mfd.;
GL—Durham metallized resistor, 2 meg.;
R2—Carter combined midget rheostat and filament;
S1—Switch, No. 10 MS, 10 ohms;
R3 and R4—Amperites, No. 1A;
R5—Amperite, No. 112;
J—Carter short jack, No. 1;
S2—Carter "Imp" antenna switch No. 12;
10 Eby binding posts;
2 Mar-Co Vernier dials, No. 192;
P—composition panel, drilled and engraved;
U—composition sub-panel, drilled;
2 Hammarlund shields;
VC4 and VC5—equalizing condensers;
R1—fixed resistance, 2 ohms;
Extension shaft for condensers.
Cost of Parts: $63.05.



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A favorite device of the fake fortune tellers is here used for a real scientific purpose. The familiar crystal ball is employed by Professor J. B. Morgan, of Northwestern University, in investigating the psychology of day-dreaming.

Underwood & Underwood

The QUACK DOCTORS *of* RADIO

Part II. The Fake Fortune Tellers

In the first article of this series, which appeared in the August 1926 issue of POPULAR RADIO, Dr. Free exposed the efforts of quacks and charlatans to use radio terms and radio devices to impress victims seeking help for ill health. In this article he discusses the no less despicable misuses of radio by the harpies who prey on the credulity of men or women who ask to "know the future."

By E. E. FREE, PH.D.

THERE are two subjects about which men and women will pay almost anything to be fooled; one is the future and the other is themselves.

Tell a man that by observing tea leaves in a cup or dealing cards out on a table or conducting some other mysterious hocus-pocus you can glimpse the future of his business deals or the outcome of his love affairs, and he will turn his pocket book over to you and let you turn it inside out at your leisure.

Tell a woman that you can determine by some new and secret scientific device the percentage of "charm" that she possesses, or perhaps how to obtain more of this much-desired commodity, and she will lie in wait for every stray

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nickel until she has amassed your fee.

These are human weaknesses. Great men have suffered from them. Fortune tellers have always thrived, never more so than today. And nowadays, like the quack doctors who prey upon the ill, these harpies of prediction have added radio and other marvels of modern science to their kit of tools.

The Reproduction of "Supernatural" Voices by the Fakers of Spiritism

The use of radio apparatus to produce mysterious voices or other sounds, supposed to be of supernatural origin and of weighty import, is the simplest of these devices; it was described months ago in POPULAR RADIO* by Houdini. And of course the fakers who set out to use radio devices to assist their magic or to help create an impressive atmosphere of mystery in their seance rooms are careful to exclude, so far as possible, any clients who actually know anything about radio and who might see through and expose the fake.

There have been for many years a number of ways in which voices, apparently disembodied, may be created in seance rooms. Ventriloquism is possibly the earliest and most popular, although the ancient device of the concealed speaking tube still retains a well-deserved following among the profession. Radio is merely an improvement on this. It provides a speaking tube which needs no material connection. A confederate outside at a peep-hole, a small oscillator and a concealed receiver and telephone, and it is easy to astonish the prospective victim by remarks neither the source nor sense of which he can understand. It seems to make little difference how often the devices and methods of these fakers are exposed; their clients reappear to be duped in ever increasing numbers.

The "Human Aura" Fake, and Its Relation to Ether Waves

Closely related to radio and to its associated portions of general physical science also are the delusions which cluster around the idea of the "human aura."

This aura business possesses an ancestry almost as respectable as astrology. Many of the philosophers of antiquity held that there was given off from the human body a perceptible something, commonly thought of as having essentially the nature of an odor, although a much more delicate and subtle one than ordinary smells. This is probably quite true; we know that different races do differ slightly in body odor. Individuals probably do the same, as our dogs' noses well know. The savants of antiquity may be assumed to have known this, and their references to the human aura probably mean nothing else.

But as the centuries passed and the ancient tongues were forgotten, these statements, like so many others among ancient dogmas, began to be interpreted mysteriously. And then, a few years ago, a German photographer made a discovery that gave the whole aura mystery new life; he actually photographed a human aura on a photographic plate. Around the edges of the portraits which he obtained appeared a fringe of what looked like light. The aura as a kind of radiation, mysterious, invisible and imperceptible to our senses, appeared among human delusions.

The method of the German photographer was soon exploded. Any expert in trick photography can make for you, nowadays, as many aura photographs as you wish to pay for. The secret is the presence in the photographic plates of any one of several chemical substances which cause the image to spread on the plate, so that an apparent photograph of a fringe of light results. So firmly fixed, however, is the idea of an aura as some kind of radiation that it has even appeared under the definitions in the cross-word puzzles, and is doubtless in the dictionary itself.

When physical science discovered the extensions of the ether-wave series into the very short and very long ether waves, these facts were seized upon by the aura advocates. Human auras are now ascribed to various varieties of "rays," within and without the radio series. "When so marvelous a thing as radio is actually and provably real,"

From a photograph made for POPULAR RADIO

Houdini Listens to the Mystic Voice

No one was more active than the late magician, Mr. Harry Houdini, in exposing the tricks and deceits of the fake spiritualist and fortune teller. Objects as simple and familiar as a tea kettle may serve to hold the radio apparatus which these harpies use to impress and mystify their victims.

*In the issue of October, 1922.

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say the pro-aura arguers, "why may we not believe that some other variety of radio waves exist and create auras?" The answer is, of course, that you may if you want to. There is no law compelling people to disbelieve in foolishness.

An extension of the aura idea is the more recent one of some special human "ray," capable of accomplishing marvels, either toward other humans or on physical apparatus. The ancient superstition of the "evil eye" is a case in point, but it was matched last year, in England, when an alleged scientist announced that he had perfected an apparatus which could be moved by the glance of the human eye, apparently without any other agency whatsoever. Although I attempted to obtain a copy of this apparatus or directions by which it could be built, I was unsuccessful. The inventor has never submitted it to independent scientific test. We cannot imagine any way in which the eye could project energy of any kind, let alone enough of it to move any mechanical system, and it is probable that the apparatus is to be written down as pure fake.

The "Character Meter" That Operates Through a "Mysterious Radiation"

The idea has come over to the United States in the form of a device that is certainly pure fake. This is the so-called "character meter." Although constructed somewhat variously by different fakers who have used it, this apparatus usually consists of some device similar to the little radiometers of opticians' windows, the tiny whirligigs which revolve rapidly inside their glass bulbs whenever the sunlight falls on them. The character meter, however, requires no sunlight. You merely put your face close to it and gaze intently at the internal mechanism. This mechanism moves. There is no revolution of the vanes, as in the radiometer, but a needle moves across a scale or a pointer turns or some other measurable thing happens. The claim is that some mysterious "radiation" from the human eye of the gazer has affected the apparatus and that the intensity of the movement inside the instrument indicates the strength of the "personality" or "will power" or what-not of the subject being tested.

This procedure is undeniably an impressive one, especially when it is displayed to a person who has merely heard some vague rumors of the "new radiations" discovered in recent years and who is prepared to believe that some one of these newly-discovered rays might really emanate from the human eye or from whatever part of the human body the factor of "personality" is supposed to inhabit.

The truth, however, is quite simple. The apparatus is actuated by the heat of the face. It will work equally well if a hand or any other part of a living body is held in front of it, or if the body is replaced by nothing more mysterious than an ordinary hot water bag well filled with the usual heated liquid. An equally instructive result would be obtained by holding a thermometer against the skin. A certain amount of radiant heat is given off by the face, as well as by any other warm body. Delicate instruments will detect this heat without any difficulty whatsoever.

As to the records of strong or weak personality yielded by these devices, they are no more than records of the hotness and nearness of the face in front of the instrument. A man with a fever would register a personality transcending that of Napoleon Bonaparte himself.

There used to be sold in toy shops, by the way, a still simpler device for measuring "personality," although no one had the face to say that it operated by any mysterious radiation, radio-like or otherwise. This was a small strip of gelatin, a few inches long and about an inch wide. Placed on the open hand, held palm upward, this little gelatin strip promptly curled up, like a photographic print allowed to dry unpressed. The degree and promptness of the curl were supposed to indicate the "personality." What they did indicate, of course, was merely the moisture of the palm of the hand. The cook, with her hands fresh from the dishwater, invariably had the strongest personality of all present.

"Character-Revealing" Devices That Are Explained by Words Borrowed from the Language of Radio

Another and more modern variation of these character testers consists of a pendulum which is allowed to swing from the finger over a sheet of paper, frequently with letters or figures inscribed on the paper. If you try this experiment, using any small weight, like a penknife, tied to a string about twelve inches long and holding the upper end of this string in your fingers, you will discover that the weight at the bottom end of the string will begin to swing backward and forward in one direction or another. From moment to moment the direction of this swing will change. If the sheet of paper carries the letters of the alphabet, inscribed in a circle like the figures of a clock dial, the pendulum will swing successively to a series of these letters. Set down in order, these letters sometimes spell words. Thus the device operates exactly as does the famous and unlamented ouija board.

As a character measurer the device is not used to spell words, but the pendulum is arranged to trace a design on the paper, for example, by passing a fine-pointed and very soft pencil through a loose staple carried by the weight of the pendulum. The shape and size of the design drawn is supposed to have a most profound meaning concerning the person who made it. Again we run

(*Continued on page 49*)

Courtesy of the N. Y. World

Will Your Character Make This Meter Shine?

One of the many forms of "meter" for testing character or personality consists of two metal plates connected by a wire and stood upright in a glass beaker which holds a "sympathetic" solution. The observers link hands around the table. If the personality concentrated in the circle is great enough, the top plate of the meter is supposed to glow with light; strong for vigorous personalities, weak for feeble ones.

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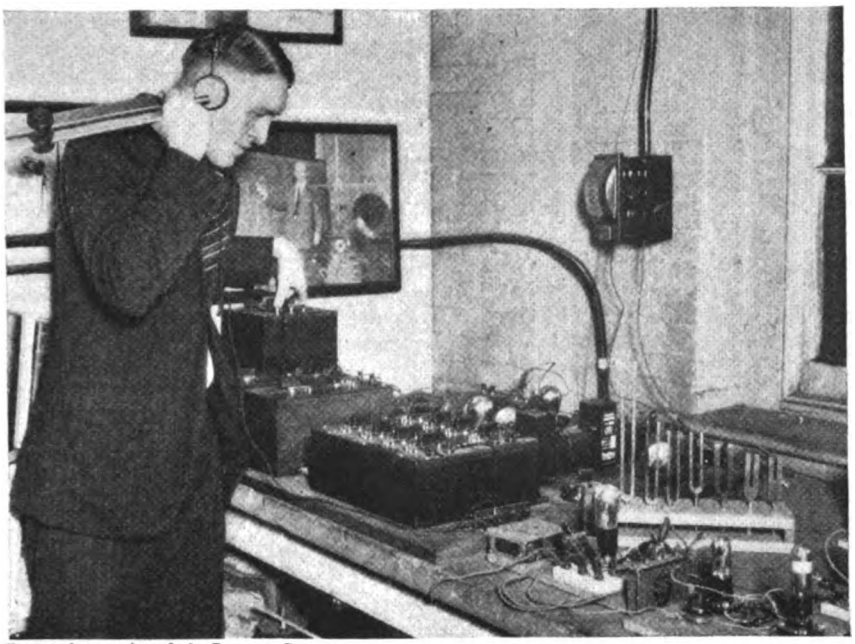
¶ *A simple explanation of the functions of resonance and resistance in electrical circuits that will help the fan to understand how his radio set works.*



From a photograph made for POPULAR RADIO

HOW TUNING FORKS ARE USED TO TUNE AN ELECTRICAL OSCILLATOR

The oscillator is set generating a frequency that may be judged by the ear to be about the order required; the standard tuning fork of a definitely known frequency is then struck and the sound applied to the headphone that is at the same time receiving the electrical oscillations from the oscillator and converting them into sounds. The frequency of the oscillator is then adjusted until it is exactly the same as that of the tuning fork by listening to the beats produced between the two frequencies. These beats cease when the two instruments are exactly in tune.

WHAT HAPPENS

When You Tune Your Set

ARTICLE NO. 2

In the first installment of this new series of articles (in the November, 1926 issue) Sir Oliver began with a simple description of waves and wavelengths; in this and the following articles he treats of the conversion of radio waves into electrical impulses in tuning circuits, or electrical resonance and its analogy to mechanical or sound resonance. And finally he will describe the new method of tuning as embodied in the new "N" circuit, with which he has long been experimenting.

By SIR OLIVER LODGE, F.R.S., D.Sc., LL.D.

THAT tuning is due to resonance, (that is, to the accumulation of small impulses which recur at the right frequency), is widely known. But few, perhaps, know the details that are associated with tuning and the extent to which the principle of resonance may be pushed.

This principle of resonance is most easily illustrated by sound.

If two similar tuning forks are mounted on resonating boxes or are fixed to the same sounding-board, and one of them is excited, the other responds and begins to vibrate in spite of the fact that it is a stiff mass of steel that has to be set in vibration. But the tuning must be accurate.

If one of the forks is slightly warmed they will be thrown out of tune and there will be no appreciable response.

Another way of throwing them out of tune is to stick a bit of beeswax on one of the prongs of one of the forks. The wax acts as an extra load so that the impulses are not properly timed. The forks will then get out of phase, say in half a second, and, as they are then in opposition, they undo any impression which they may have made during the first quarter of a second.

Such forks, if sounded together, will beat together and produce another note which is an example of heterodyning.

Suppose one fork makes 256 vibrations a second, while the other makes 254.

If they are sounded together there will be two beats a second, the combined sounds swelling out and dying away twice a second; this gives a beating sound which goes on as long as the simultaneously excited forks continue to vibrate at all. They give out just as much sound as before, as they are twice as strong as one fork alone.

If they were exactly in tune the sound would be a continuous wave of steady pitch, naturally twice as strong as one fork.

When they are out of tune the sound emitted is not a continuous wave but an intermittent one. It swells up to a maximum twice as strong as the continuous wave would have been, that is, four times as strong as one of the forks: then the maximum is followed by an

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interval of silence, then another maximum, and so on. The increased maxima compensate for the minima, the rate of intermittence being the difference between the two rates of vibration.

If one fork is 256, while the other is 252 or 260, there will be four beats a second. If the difference in vibration is greater than that, so that the difference gives (say) 15 beats a second, the forks are decidedly out of tune; so that if they were to be sounded separately the ear would detect that one was a semi-tone higher than the other.

The beats would then be too rapid to be heard separately; they would merely give an unpleasant flickering or fluttering sensation which is called discord.

Two notes a semi-tone apart sounded together on any instrument are well known to be discordant. Helmholtz's Theory of Discord is that it is due to rapid indistinguishable beats.

This simple principle of beats is used in heterodyning, because electrical vibrations are so extremely rapid that no mechanical instrument can respond to them. No piece of matter can vibrate as fast as electrons can.

Electrical vibrations are reckoned in millions a second. But if we have two sources, one a million a second, the other 999,000, the difference in their rates of vibration is one thousand; so that the two vibrators will give a thousand beats a second.

An acoustic instrument like a telephone diaphragm can easily respond to a thousand a second; giving a note that may easily be audible to the ear. The middle C on the piano, which is the middle C between the treble and bass clefs, usually has 264 vibrations a second. The C in the treble clef is 528. The next octave above that is 1056, and that is perhaps the note or pitch to which the ear is most sensitive.

It is true that in order to convert the electrical vibrations into acoustic vibrations the alternating waves must be rectified; the negative pulses suppressed, and only the positive ones used.

This is the object of a crystal or a vacuum tube used as a detector. The crests of the waves, thus rectified or freed from their opposite components, then merge together to produce an electric current, all of one sign. They combine their effect on the telephone diaphragm, giving it a pull in one direction all through that part of the beat, which lasts only, say, one two-thousandth of a second.

Then comes the interval during which the diaphragm recovers, ready to be pulled again by the next beat; and so the diaphragm is repeatedly thrown into vibration by the intermittent current whose maxima and minima last each for the one two-thousandth part of a second. Thus though the full-wave disturbance would produce no mechanical effect, because the vibrations are far too rapid to move the diaphragm but the intermittences or beats due to the superposition of the two rectified vibrations do cause an audible note of pitch a thousand a second.

So far we may consider the principle to be well-known and in common use. The interference of two audible sounds produce audible beats without any rectification, because the whole of the disturbance is within the range of audibility, and is not too rapid to affect matter.

Ether vibrations, however, are far too rapid to affect matter; they must be rectified, and then their beats may be heard, not as a beating note, but as an audible frequency. Nothing was heard until they were rectified; and then only the combined or resultant effect of the beats is heard,—heard as a clear note representing the difference in the original rates of vibration.

Something of the same sort happens in sound. Two tones strongly sounded together, even when they are far apart in pitch, give what is called a "difference" tone, which musical ears can appreciate.

For instance, suppose they differ by fifty vibrations a second. When sounded together there will be heard a low growl, deep down in the bass, of pitch fifty per second. Their beats have combined to produce such a tone.

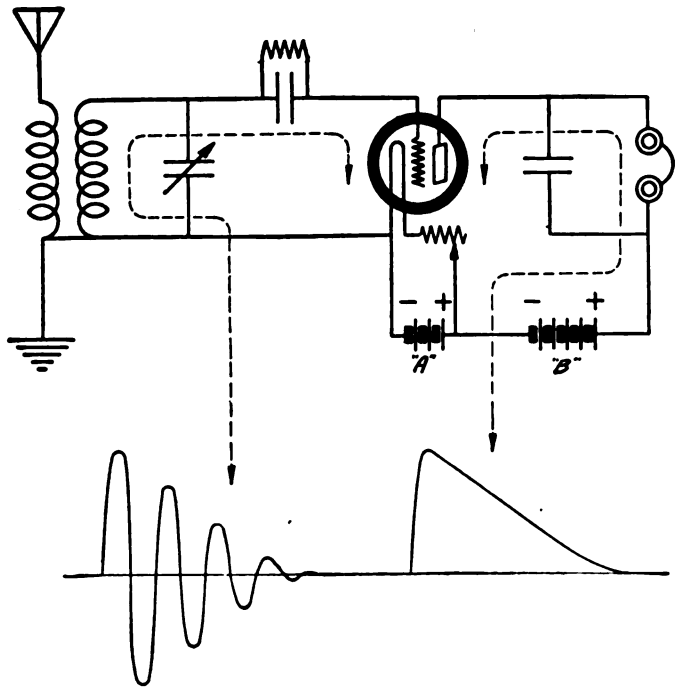
That is not the orthodox explanation of "difference" tones, for a complete theory shows that there are not only "difference" tones, but also "summation" tones. For instance, suppose the two notes are two hundred and three hundred a second each. They will have a "difference" tone of one hundred, and a "summation" tone of five hundred.

The theory of these involves what is called the second order of small quantities, and is not as simple. They are called, in general, combination tones. Of these the "difference" tones are the loudest, the "summation" tones the next; and there are others, represented not only by $p-q$, and $p+q$, but $2p-q$, $2p+q$, pq, and others, which, however, are too feeble to be readily heard.

All these, no doubt, exist also in the electrical case, when two antennas nearly of the same pitch are excited together, or when one of them is excited by two powerful rates of vibration. The only thing used in practice, however, is the "difference" tone, which is most easily thought of as a tone resulting from the beats, and is employed in heterodyning. The heterodyning may be accomplished either at the sending or the receiving end, with many details which are known to practical radio telegraphers.

The only complication in the electrical

(Continued on page 52)



HOW A VACUUM-TUBE DETECTOR WORKS

Radio-frequency impulses, represented diagrammatically by the curved line in the lower left-hand portion of the diagram, actuate the grid of the vacuum tube by following through the tuned circuit connected with the grid. These separate impulses add up, through the actions of the tube, into one single audio-frequency pulse, represented diagrammatically in the lower right-hand corner. This is the impulse that flows through the plate circuit of the vacuum tube and produces the sounds that we hear in the loudspeaker.

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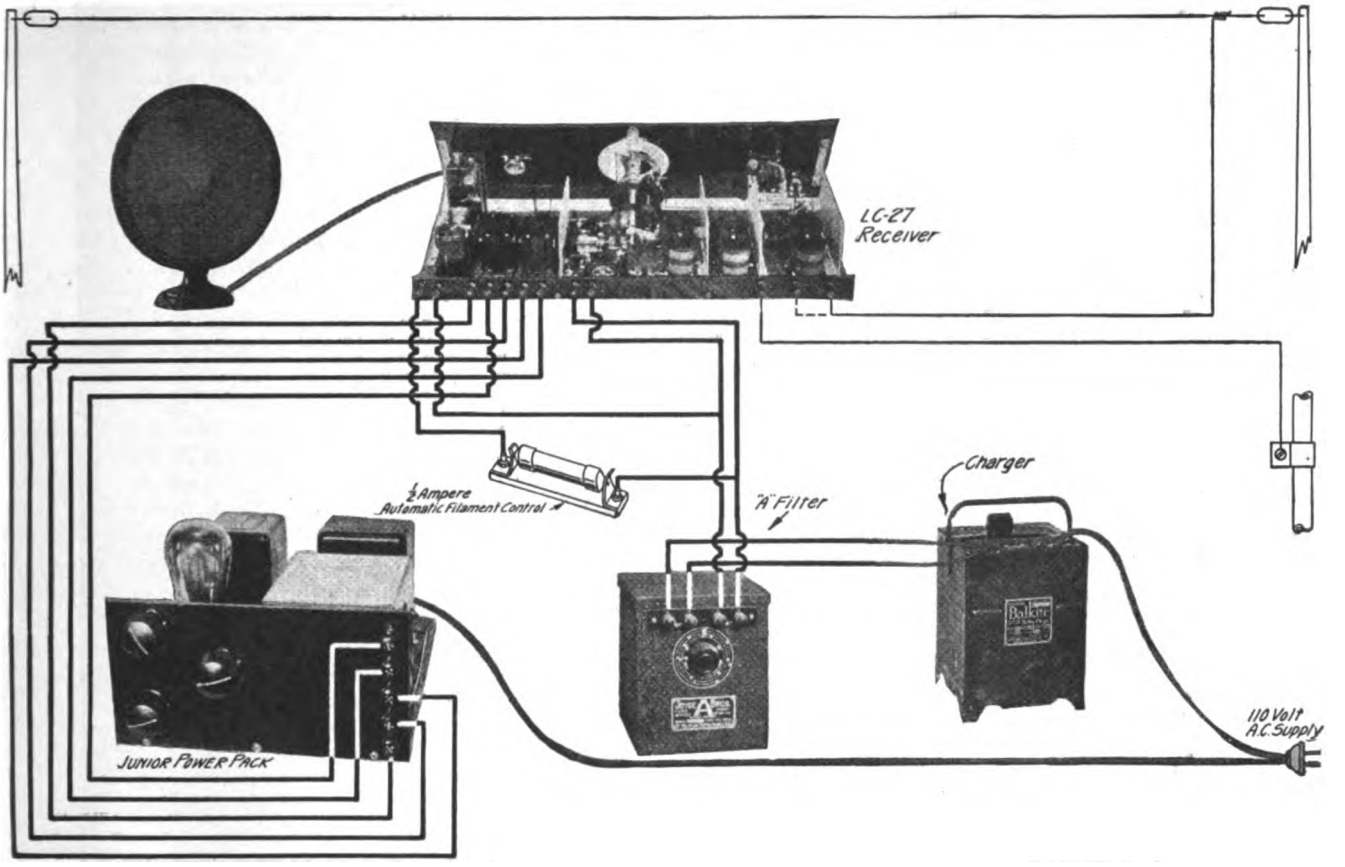

HOW THE POWER UNITS ARE CONNECTED

FIGURE 1: *This picture-wiring diagram shows the LC-27 Receiver connected up with the "A" "B" and "C" power units and to the antenna, the ground and the loudspeaker; the 110-volt AC input to the charger and to the Junior Power-pack are connected in parallel to the lighting lines by means of a standard connection plug.*

HOW TO BUILD THE

LC-JUNIOR POWER-PACK

While this highly efficient but low-cost power unit has been designed especially for use with the LC-27 Receiver, it may be used with equal results with any receiver that uses a power tube in the last stage

By LAURENCE M. COCKADAY

COST OF PARTS: *Not more than $39.50*

HERE ARE THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS UNIT—

A—Silver-Marshall power transformer, type No. 329;
B—Silver-Marshall unichoke, type No. 331;
C—Any approved type UX socket (Klosner socket illustrated);
D1 and D2—Sangamo filter condensers, series B, 2 mfds.;
D3—Sangamo filter condenser, series B, 4 mfds.;
D4 and D5—Sangamo filter condensers, series B, 1 mfd.;
D6 and D7—Sangamo filter condensers, series B, .1 mfd.;
E and F—Any approved variable resistance (Clarostat resistance illustrated);
G—Any approved high-current variable resistance to dissipate 5 watts, 2000 ohms (Centralab resistance illustrated);
H—Any approved fixed resistance, 10,000 ohms (Bradleyohm resistance illustrated);
I—Lynch resistor mounting;
J—Hardwood baseboard, 9 by 11 by ½-inch;
K—Bakelite panel, 4½ by 9 by 3/16-inch;
L1, L2, L3, L4 and L5—Any approved binding post (Eby posts illustrated);
One set of POPULAR RADIO blueprints for LC-Junior Power-pack.

HERE is a third power-pack for the LC-27 Receiver—and one that is particularly suited to the needs of the experimenter who wants a unit that is both economical to build and efficient in operation.

Although the cost of this unit has been reduced to the lowest possible figure none of the necessary operating features have been sacrificed; the power-pack will be found altogether suitable for use with power tubes of the UX-171 or UX-112 type.

This unit has characteristics similar to those of the LC-Senior and the LC-Intermediate power-packs except for two points: the filament current for the last tube in the set is furnished by the "A" power unit and no relay is used.

The quality of reception obtained from the receiver when this unit is used should be of the same high order as with its larger brothers. The power-pack will supply at least 180 volts for

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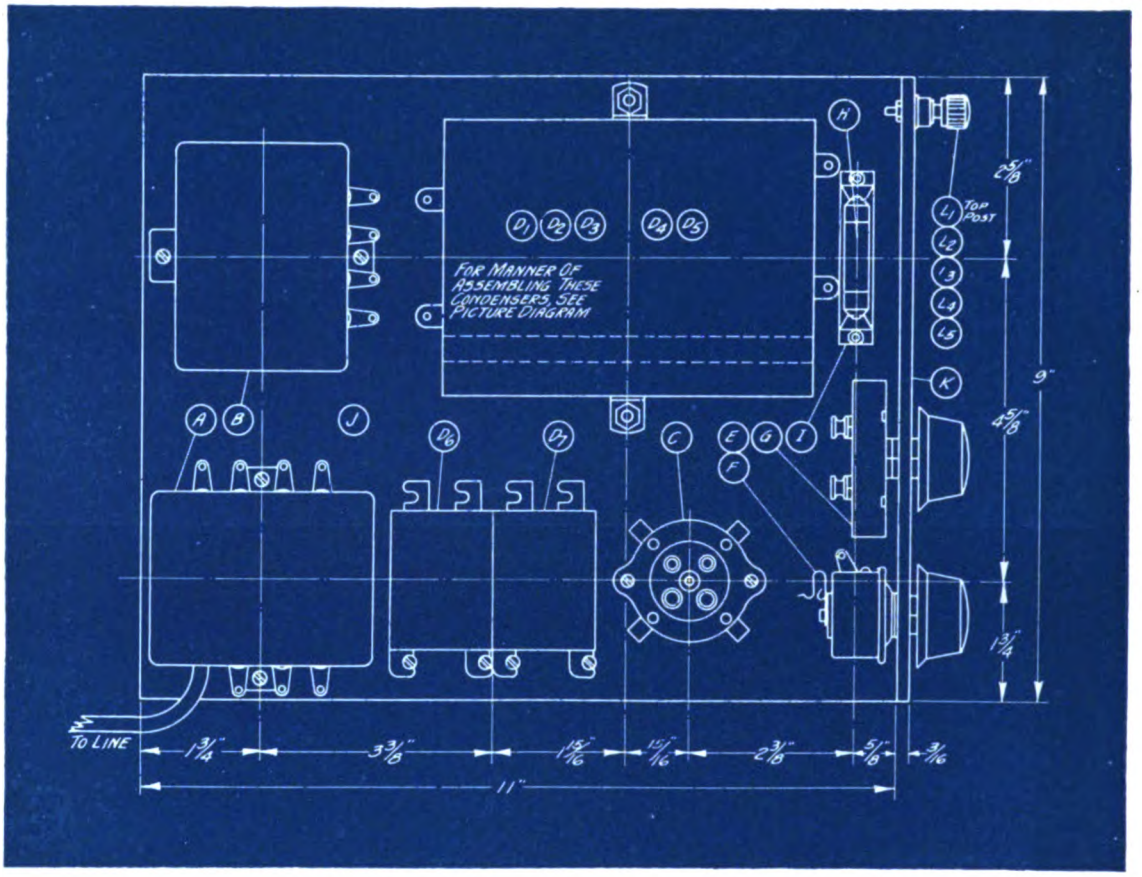
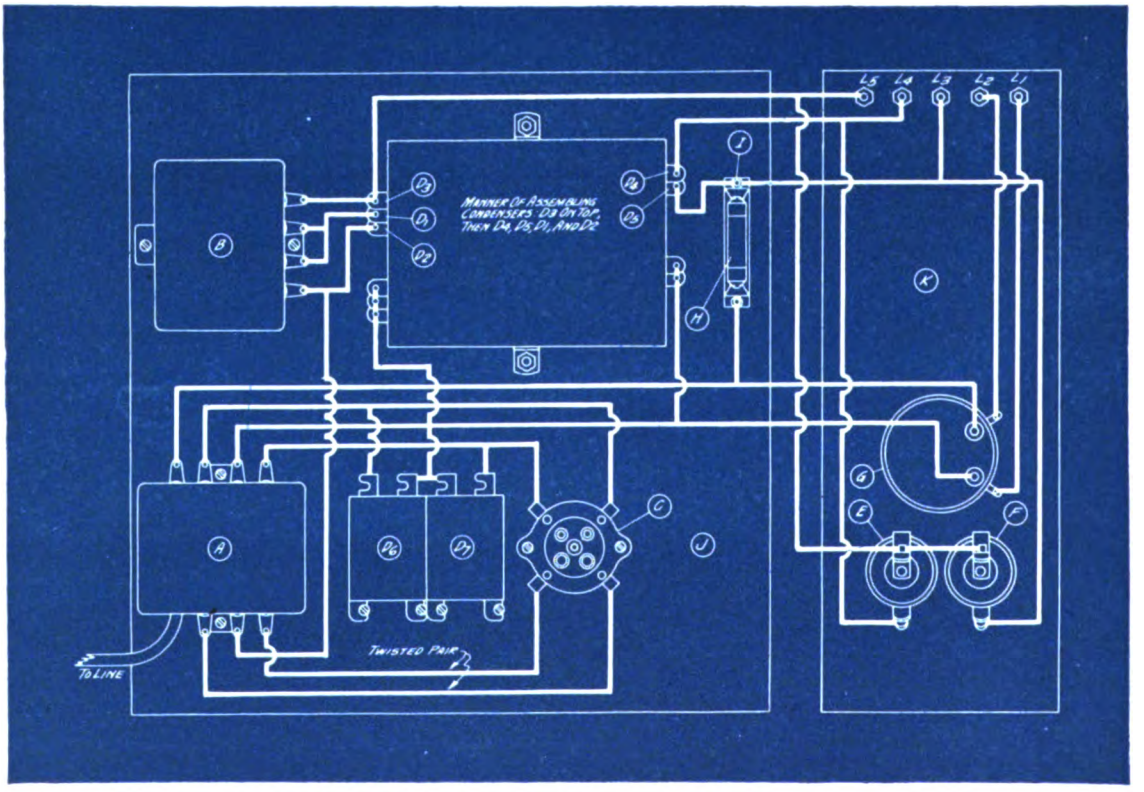


THE WORKING DRAWING FOR CONSTRUCTION

FIGURE 2: *All of the parts are shown in their exact positions, given from centre to centre of each of the instruments.*



THE PICTURE-WIRING DIAGRAM

FIGURE 3: *The instruments in this diagram are drawn in about their relative positions and the wiring is shown in heavy white lines.*

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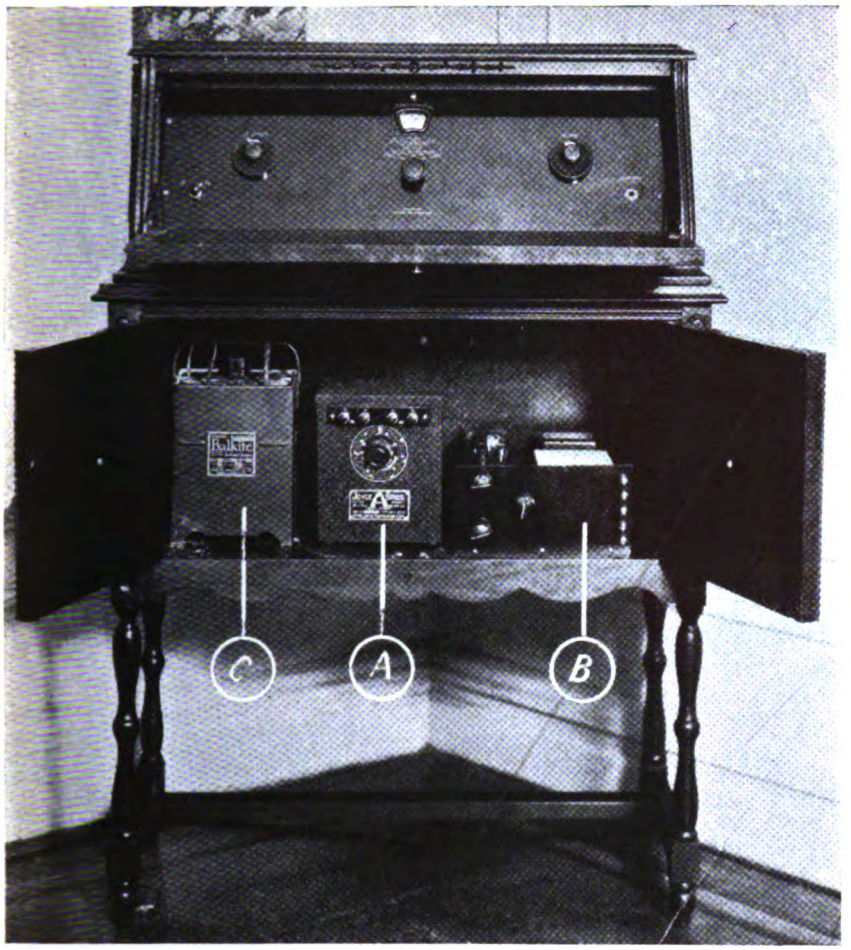


THE "A" AND "B" POWER-PACKS INSTALLED

FIGURE 4: *In the cabinet proper, on top of the table, is shown the receiver; the table compartment holds the charger, C, at the left, the filter unit, A, in the centre and the Junior Power-pack, B, at the right.*

the power tube that is used in the last stage, and a variable voltage for the radio-frequency, the first audio-frequency stage, and the detector tube plate circuits. A variable "C" battery potential is also available from this unit for the power tube. The LC-27 receiver, when operated from this power-pack in conjunction with the 110-volt, 60 cycle, alternating current supply, will give lifelike reproduction and plenty of volume for ordinary home use.

How to Construct the Unit

After all the instruments and materials for building the power-pack have been procured, the baseboard, J, should be cut to the correct size, as shown in Figure 2. It should be smoothed with sandpaper and given a coat of stain and shellac.

Next, the small panel, K, upon which are to be mounted the binding posts and the voltage controls, E, F and G, should be prepared, as shown in Figure 5. When all the holes have been drilled, the seven binding posts should be mounted and the variable resistances, E, F and G, should be fastened to the panel, as shown in Figures 2, 3 and 7.

The panel, K, may then be fastened on one of the long sides of the baseboard, J, by means of three screws, as shown in Figure 1. These screws are inserted through the three holes in the panel into the edge of the baseboard, J. They should be strong wood screws.

Next, mount the transformer, A, by means of two strong, short, wood screws to the baseboard, J, and mount the unichoke, B, in the same way. The positions for these instruments are given in Figure 2.

Next, mount the two small condensers, D6 and D7, as shown in Figure 2 and 6. This will require four, short, round-head, wood screws.

Then, mount the socket, C, with the large holes turned, as shown in Figure 6. This will require two flat-head wood screws.

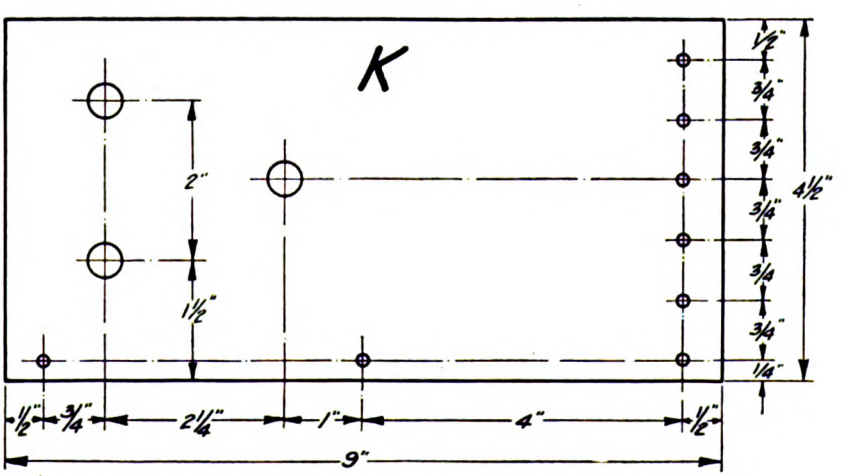
The resistance mounting, I, should then be fastened down to the baseboard and the resistance, H, put in place in the clips.

The last construction job will be to mount the high-voltage condensers, D1, D2, D3, D4 and D5. These should be mounted in the following order:

D1 and D2 are placed first on the baseboard, J, with the terminals pointing toward the unichoke, B. Then, condensers, D4 and D5 are placed on top of these with the terminals pointing toward the panel, K. Lastly, the large condenser, D3, is placed on top with the terminals pointing toward the unichoke, B. All the lugs that are used for fastening the condensers down are lined up and a long machine bolt is put through them from the bottom of the baseboard and a nut screwed on to the end of this bolt, as shown in Figure 6. On the other side, the top condenser (D3) lug will extend out and away from all of the other lugs, and should be fastened in a similar manner, except that the bolt used for this purpose will not go through the bolts on the lower condensers but will be fastened tightly and hold the condensers in position by pressure. This side of the bank is shown in Figure 7.

This completes the construction work and the unit is ready to be wired.

(*Continued on page 78*)



HOW THE BINDING POST PANEL SHOULD BE MADE

FIGURE 5: *This drawing gives the exact size of the small panel, K, with the drilling hole locations for mounting the binding posts, the three mounting screws and the three variable resistances.*

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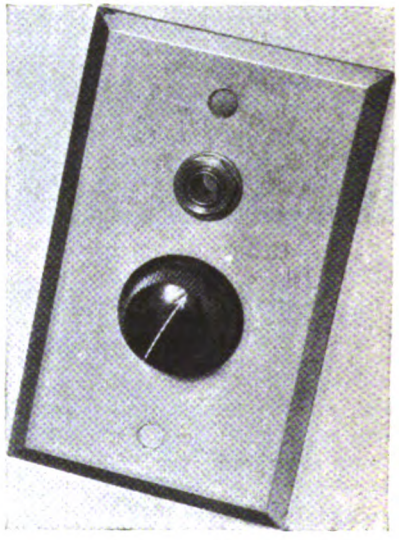
What's *in*

Apparatus that is of broadcast listeners and genious and practical up-to-date fan

Conducted by
THE TECHNICAL STAFF

A RECEIVER BUILT ON A BABY-GRAND MODEL

This unique console contains a home-made, six-tube, tuned-radio-frequency receiver; the top of the piano acts as a sound board for the loudspeaker mounted beneath. It belongs to Miss Violet Herbert.



A Plug for an Extension Loudspeaker

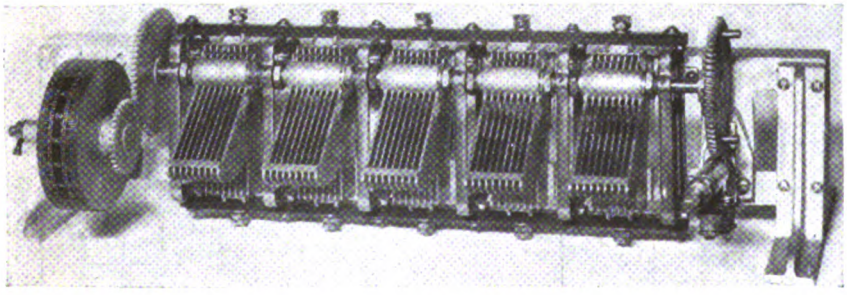
Name of instrument: Combination loudspeaker jack and volume control for wall mounting.

Description: This device may be connected to the wall and used in a distant part of the house for an extension loudspeaker connection. It consists of a jack with a series variable resistance, by means of which the loudspeaker may be plugged in and the volume tuned up or down to just the right degree without affecting the setting of the set. By this means the receiver on the other end of the line may be set for large volume and loudspeakers installed throughout the house with the volume controlled in the room to just the desired strength.

Usage: In connection with a receiving set and loudspeaker as an extension.

Outstanding features: Makes house wiring for radio easy. Neat in appearance. Easy volume adjustment.

Maker: Carter Radio Co.



A Gang Condenser that Makes a Set "Single Control"

Name of instrument: Five-gang condenser.

Description: This condenser combination contains five variable condensers mounted on a carefully designed and constructed chassis with a single shaft that is connected through a worm geared arrangement to an auxiliary shaft on which the dial to operate the set may be mounted. At the other end of the unit is a geared drum that carries the dial settings for the receiver. A perfect balance may be obtained in all of the circuits by varying the position of any one or all of the rotor units in relation to any one unit.

Usage: In a receiver for producing true single-control operation.

Outstanding features: Elaborate and well carried out design. Easy to install. Easy to balance. Fine workmanship.

Maker: Perlesz Radio Corp.

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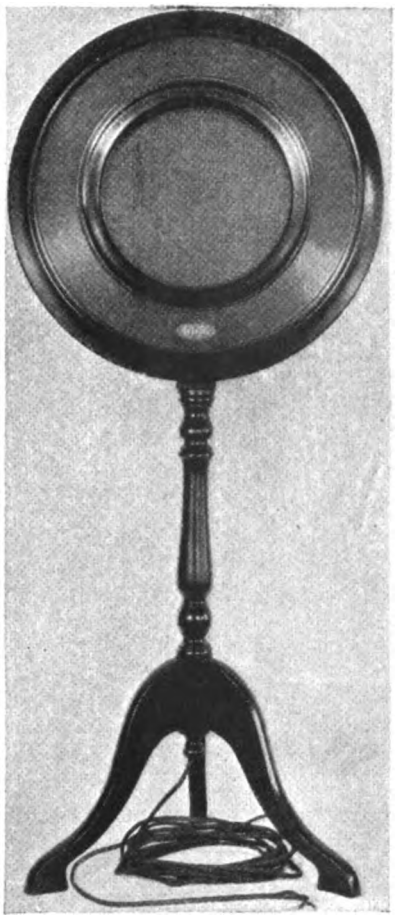
New Radio

interest and value to to experimenters; ininventions that the should know about

Illustrated with photographs made for POPULAR RADIO

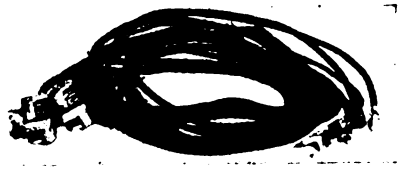
A Compact Automatic Charger that Employs a New Trickle Charger Tungar Tube

Name of instrument: Trickle charger.
Description: A small, compact unit that is housed completely in a fireproof ventilated metal case. It is equipped with a switch for turning "on" and "off" and a meter for indicating the relative rate of charge. It is furnished complete with the proper extension leads for the alternating current lighting mains and also for connecting to the batteries to be charged.
Usage: In combination with a storage "A" battery for keeping the battery at the best working condition.
Outstanding features: Compact. Easy to install. Needs no attention. Keeps battery fully charged.
Maker: Sterling Mfg. Co.



A Loudspeaker Built Like a Tip-top Table

Name of instrument: Cone loudspeaker.
Description: This reproducing unit, which is housed in a small table top and is mounted on a tripod similar in appearance to a tip-top table is unique in design and reproduces radio broadcast signals with a wealth of volume and with excellent tone quality, including all the high and low notes. It is finished in two-tone polished walnut and is equipped with an extension cord that enables the loudspeaker to be moved to various portions of the house.
Usage: As a reproducer of broadcast programs in the home.
Outstanding features: Neat appearance. Fine tone quality. High efficiency from a volume standpoint.
Maker: Rola Co.

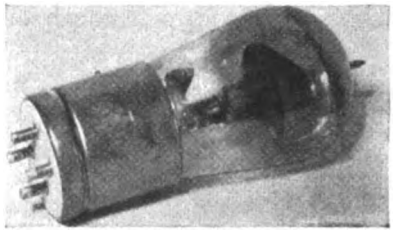


A Connector Cable that Simplifies Set Installation

Name of instrument: Battery cable.
Description: A unit that contains wires for connecting the storage battery and the "B" batteries to the set terminals. The wires are insulated and covered with a braided covering. Connectors that are easy to attach are supplied for the battery terminals and for the binding posts.
Usage: For a receiving set installation between the batteries and the receiving set.
Outstanding features: Easy to install. Makes a neat installation. Good contact.
Maker: Birnbach Radio Co.

A Resistor that Maintains a Constant Value

Name of instrument: Resistor unit.
Description: This resistance utilizes a glass tube which is coated on the inner surface with a resistance film that is carefully baked to make it permanent. On each end of the resistor, a low-resistance film makes contact with the brass ferrules so that the contact resistance will not change. The resistance values are accurate and remain permanent.
Usage: In any place in a radio receiving apparatus where accurate resistance values are necessary.
Outstanding features: Permanent. Accurate. Easy to install. Neat in appearance.
Maker: Daven Radio Corporation.



A New Tube that Gives High Voltage and Consistent Operation in Power-packs

Name of instrument: Rectifier tube.
Description: The new-type Raytheon rectifier, known as the BH type, has a greater output than the old type of tube and will satisfactorily furnish 85 milliamperes on continuous rating. When used in the old style Raytheon power-pack it will increase the voltage output by at least 25 to 30 percent. When used with the new type Raytheon units, it will supply even higher power and insure satisfactory service and maximum output from the UX-171 tube when used as an audio-frequency amplifier in the last stage in a receiver.
Usage: As a rectifier tube in a "B" power-pack.
Outstanding features: Higher power. Rugged construction. Will serve as a rectifier for furnishing "A," "B" and "C" voltages for the 199 type tubes. Will furnish "B" and "C" power for UX-171 and UX-112 type tubes. Uniform characteristics. More consistent operation.
Maker: Raytheon Manufacturing Co.

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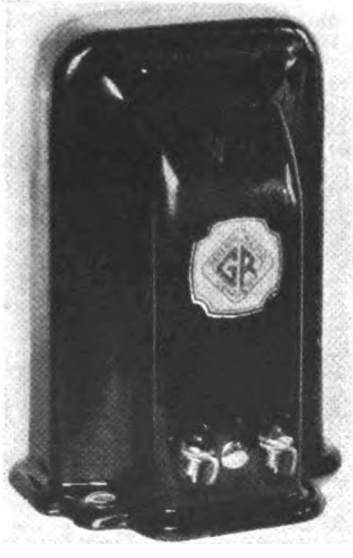
Underwood & Underwood

A RECEIVER THAT IS TUNED BY PUSH-BUTTONS

All you have to do to tune in a station is to push one of the buttons on the switchboard; this actuates an electrical relay and tunes the set to exactly the right wavelength. There are eight relays in all, which may be adjusted to tune in your eight favorite stations.

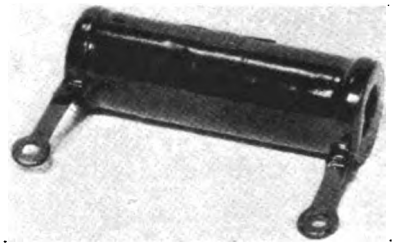
A Voltmeter for Radiola Superheterodynes

Name of instrument: Swivel jack voltmeter.
Description: This voltmeter is compact in size and is enclosed in a neat metal case finished in black. The voltage scale and hand are white while the dial is black; this makes for high visibility. The range is from zero to 6 volts and the dial scale is so calibrated. The instrument is equipped with a small switch by means of which the meter may be connected in the circuit at will. The terminals are in the form of two pins which are inserted in the small jacks provided for this purpose on the Radiola receivers. These pins are arranged on a swivel mounting to permit the meter to be turned at any desired angle.
Usage: To measure the voltage applied to the filaments of the tubes of any receiver equipped with the proper pin jacks—notably the Radiola and the receivers incorporated in the Victor and Brunswick combination radio-phonograph units.
Outstanding features: Neat appearance. Compact. Highly visible scale and indicator. Easy to connect.
Maker: Beede Electric Instrument Co.



A New Impedance for Audio-Frequency Amplification

Name of instrument: Impedance coil.
Description: This instrument, which is encased in a japanned metal housing, is a high grade unit for use in the popular impedance-coupled, audio-frequency amplifier. The two terminals are mounted on bakelite and extend through holes provided in the metal housing. An extension base provides lugs for attaching this instrument to the baseboard of a receiver. This unit is of the single impedance type of coil.
Usage: When used with a suitable condenser and resistance it will provide one stage of high grade audio-frequency amplification.
Outstanding features: Neat appearance. Rugged and compact. Terminals conveniently placed. Reliable design and workmanship.
Maker: General Radio Co.



A New Unit that Will Carry Heavy Currents in Power-packs

Name of instrument: Resistor.
Description: This resistance is a carefully made unit consisting of resistance wire wound on an insulating tube equipped with two soldering lug terminals, one at each end. The resistance wire is protected by a baked enamel covering to prevent oxidation. It is accurate in the values specified and will carry currents well in excess of the rated loads.
Usage: In a power-pack as a voltage divider or in any other place where resistors of high resistance values are necessary.
Outstanding features: Accurate rating. Permanent values. Neatly constructed. Easy to wire.
Maker: C. E. Mountford.

A Resistance that Will Help Reduce Noises in The Receiving Set

Name of instrument: Fixed resistor.
Description: This unit, which is made by a new process, utilizes a metallized, glass rod as the resistance element. It is of rugged construction and will stay permanently at the fixed value of resistance that is marked on the instrument. It will not produce frying sounds in receiving apparatus.
Usage: In a receiving set wherever a fixed resistance of various values may be necessary.
Outstanding features: Rugged construction. Permanence. Accurate calibration.
Maker: Arthur H. Lynch, Inc.

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A Compact Tube Charger That Reduces Battery Troubles

Name of instrument: Trickle charger.

Description: This unit, which is entirely enclosed in a fireproof metal case, comprises a charger that uses a 2-ampere Tungar tube as the rectifier and contains the necessary transformer for supplying it with voltage. It is also equipped with a switch and an output regulator to suit varying needs of charge and an extension cord and plug for connecting to the 110-volt, 60-cycle lighting lines.

Usage: In connection with a storage battery for automatic charging.

Outstanding features: Compact size. Needs little care. Keeps storage battery always up to full charge. Variable adjustment feature. Fireproof.

Maker: The Storad Manufacturing Co.

A Fixed Condenser With a Grid-leak Mounting

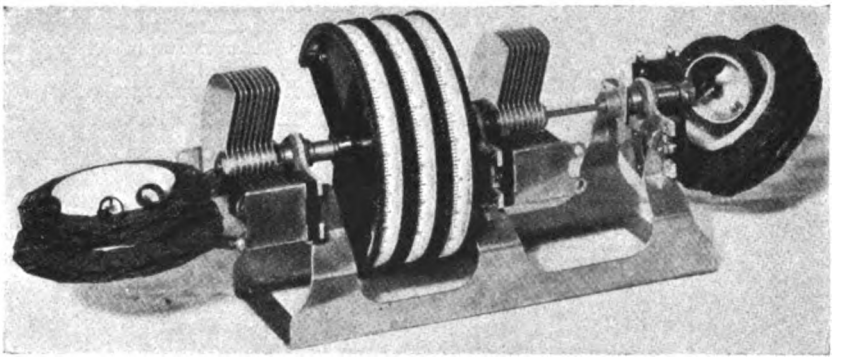
Name of instrument: Molded mica fixed condenser with grid-leak attachment.

Description: This is a carefully made fixed capacity unit; it is entirely surrounded by molded bakelite and provided with two holes for mounting with two screws to the baseboard. It also contains two clips for supporting a grid-leak and is equipped with soldering lugs.

Usage: As a grid condenser in a receiving circuit.

Outstanding features: Accurate values. Waterproof. Heatproof. Easy to install.

Maker: Pilot Electric Mfg. Co., Inc.



A Tuning Unit to Bring the Roberts Receiver Up to date

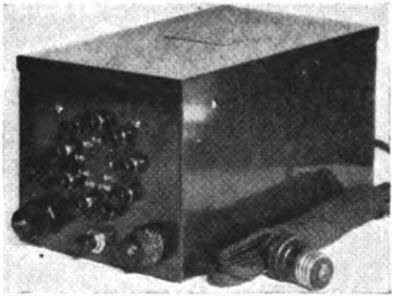
Name of instrument: Complete Roberts tuning unit.

Description: This new combination of variable condensers and coils is made especially for the Roberts circuit. It contains a variable condenser at the left which is controlled by the left-hand drum. This tunes the radio-frequency amplifier, the tap coil of which is located at the left. At the right is the variable condenser that tunes the regenerative detector and it is controlled by the right-hand drum. The center drum controls regeneration by revolving the tickler coil, shown in the center of the detector coils at the right. This unit may be installed with a cut-away panel for the drum in your old Roberts receiver, or it may be used as the nucleus for a new set and will be found to give improved results in both tuning and operation.

Usage: It may be used with the Roberts circuit.

Outstanding features: Simplified control. Easy assembly. Efficient operation. Brings an old set up to date.

Maker: Alden Mfg. Co.



A Power-pack that Replaces "B" and "C" Batteries

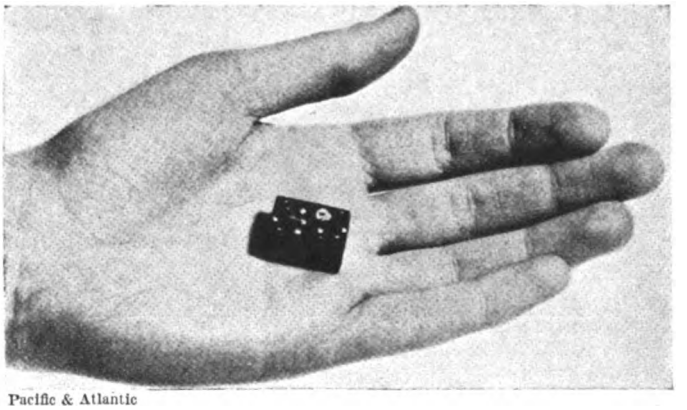
Name of instrument: "B" and "C" Power-pack.

Description: This instrument, which is enclosed in a metal container, supplies the "B" and "C" voltages for the operation of any standard receiver which requires no more than 135 volts maximum. A Raytheon tube is employed as the rectifier in this device. Output terminals are provided to supply an adjustable detector plate voltage, three intermediate voltages, 45, 67 and 90, and the high voltage, which is 135. In addition, there are terminals for a 4 and 9-volt "C" supply and, for use with power tubes, a variable "C" voltage. The latter and the detector plate voltage are adjustable by means of two knobs mounted on the front of the instrument. The power-pack is also equipped with a switch for turning it "on" and "off" and an extension cable with plug for connecting to the alternating current lighting socket.

Usage: In connection with any receiver to supply all required "B" and "C" voltages.

Outstanding features: Neat appearance. Compact. Rugged. Supplies ample variety of voltages to take care of the critical requirements of any circuit.

Maker: DeWitt-La France Co.



Pacific & Atlantic

A NEW "SMALLEST SET"

This tiny radio receiver weighs no more than an ordinary finger ring but it will bring in local stations clearly. A crystal detector is used, of course, but it is so small that a pair of fine pinchers must be used to adjust it accurately. It was built by an English fan.

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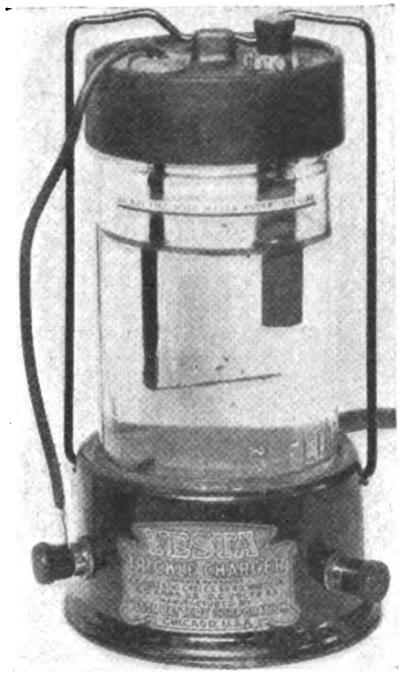
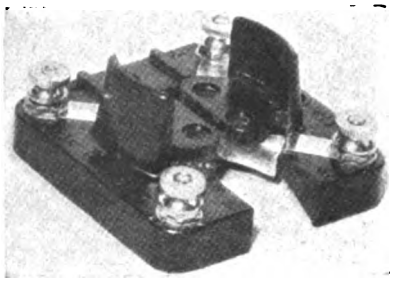


A New Trickle Charger for "Pepping Up" Batteries

Name of instrument: Trickle charger.
Description: An improved electrolytic charger that may be left permanently connected to your battery and may be relied upon to slowly charge the storage battery of a radio set and keep it in fully charged condition at all times with no attention other than an occasional addition of distilled water. The unit is practically spill-proof and may be placed directly in the battery cabinet with the battery.
Usage: In connection with a storage battery as a permanent charging device.
Outstanding features: Improved construction. Automatic operation.
Maker: Vesta Battery Corporation.

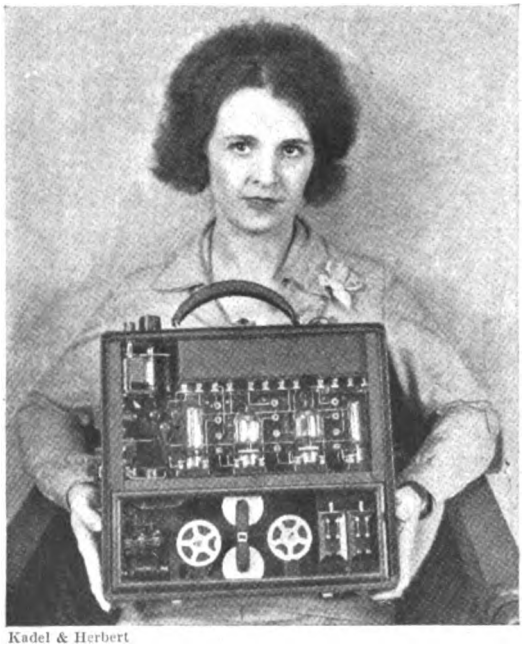


A Socket to Increase the Efficiency of Your Amplifier

Name of instrument: Vacuum-tube socket.
Description: This unit, which is of high-grade molded bakelite, is formed in such a fashion that the insulating section between the grid and plate terminals is cut away; this reduces the capacity across the circuit to a minimum value. It is equipped with spring contacts that make firm and positive connection to the prongs of standard vacuum tubes. When used in radio-frequency circuits a decided improvement will be noted in the amplification obtained in each stage.
Usage: Can be used generally as a base for standard vacuum tubes and will be found of exceptional value in vacuum tubes that are functioning as radio-frequency amplifiers, or as a detector.
Outstanding features: Extremely low capacity from grid to plate. Neat workmanship. Rugged construction. Firm contact.
Maker: Airgap Products Co.

A Transformer that Will Increase Volume and Tone Quality in Your Set

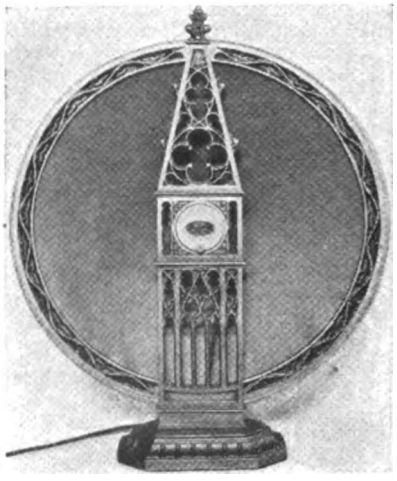
Name of instrument: Audio-frequency amplifying transformer.
Description: This is a high grade transformer for audio-frequency work that contains an exceptionally large core and windings that will increase the amplification at low frequencies to a great extent over that obtained with the older types. It is housed in a neat metal case with a strip holding the four terminals for the grid, filament and plate circuits.
Usage: In an audio-frequency amplifying circuit for producing better quality.
Outstanding features: High volume. More uniform amplification over the entire range of broadcast musical frequencies. Neat appearance.
Maker: Silver-Marshall, Inc.



Kadel & Herbert

A SET THAT RECORDS WHAT IT RECEIVES

Broadcast programs may be "canned" for future use on this four-tube reflex set built by Norman Stuckey of New York. As the music is received the impulses are recorded on a moving, magnetized wire which runs between the two reels shown at the bottom of the cabinet. The program may be reproduced later by running the wire between two magnets attached to an amplifier, as long as the impression lasts, that is, for a period of from two to three months.



An Efficient Loudspeaker of Novel Design

Name of instrument: Cone loudspeaker.
Description: This loudspeaker presents a happy combination of good reproducing qualities with fine appearance. The cone itself is 18 inches in diameter and is enclosed in an artistic metal frame, which affords protection to the delicate cone. The adjustable actuating mechanism is supported on a metal upright, artistically finished to match the frame.
Usage: To reproduce broadcast signals.
Outstanding features: Fine quality. Sturdy construction. Great volume.
Maker: Pathé Phonograph & Radio Corp.

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A New "Humless" Power-Operated Receiver

Name of instrument: The Garod "Model EA" Receiver.

Usage: For the reception of broadcast programs.

Outstanding features: Complete operation from the alternating current, house lighting lines. Nearly perfect tone quality with no hum. Good appearance. No adjustments to make. Entirely self-contained.

Description: Some of the most radical advances in radio equipment of this season are offered by this new power-operated Garod receiver as well as a reproduced tone of nearly perfect quality.

All of the operating current for the receiver is drawn from the AC lighting lines through an unusually compact power-pack that demands no attention on the part of the owner once it is installed. All the necessary adjustments in the power-pack are made in the factory and the whole receiver is tested by a service man when the set is installed to make sure that these adjustments are suitable for the special location of the individual set.

One of the most exceptional features of this receiver is its exquisite tone quality and quietness of operation. The objectionable "hum" that has been a cause for complaint in so many AC-operated sets has been eliminated in this receiver, for whatever "hum" may be found is never audible more than an inch or two from the loudspeaker. Tube noises have also been done away with by operating the filaments of the tubes at a point considerably below their normal voltage.*

A UX-199 type tube is used as the detector; this helps to eliminate noises in the receiver itself because, as a detector, the UX-199 type tube is extremely quiet.

A further reason for the fine tone quality is the careful design of the radio-frequency amplifier so that no side bands are cut and the full tonal values remain unimpaired.

Good appearance is also important in a receiver; and here again the Garod scores high. The cabinet is large enough to eliminate the necessity for overcrowding of the instruments and is of good substantial construction but, nevertheless, graceful in all its lines. The receiver and the table on which the receiver rests are a single unit. The table top is hinged and the receiver is attached directly to it. Just below this table top is a shallow compartment in which the power-pack that operates the set is mounted.

The entire table, cabinet and front panel are of mahogany and all are finished, to match, in a dark brown. The tuning controls on the receiver panel are of composition material of this same color. All of the large surfaces of both table and cabinet are broken up with a paneled effect.

The receiver employs the neutrodyne principle and makes use of five tubes. There are two stages of neutralized-tuned-radio-frequency amplification, detector and two stages of transformer-coupled audio-frequency amplification. The same careful engineering design that was employed to produce the fine tone quality and efficient operation from the house lighting lines has been made use of to develop a five-tube receiver of the highest electrical efficiency. No single detail has been overlooked which might tend to increase efficiency, durability and dependability.

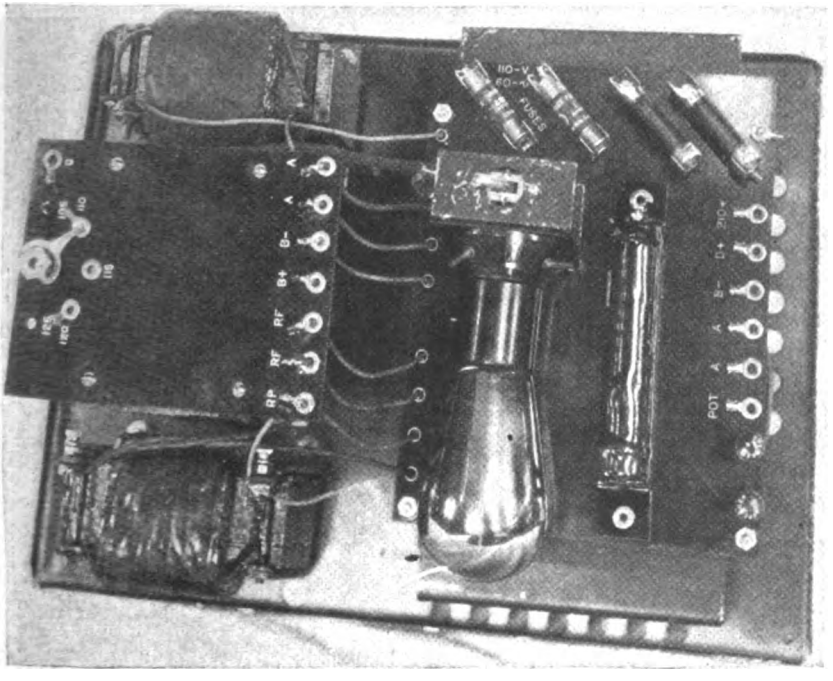
The receiver is tuned by means of the three large dials on the front panel which control the input to the first and second stages of radio-frequency amplification and to the detector. At the lower left-hand corner of the panel is a small selectivity control knob by means of which the over-all selectivity of the receiver may be adjusted to meet the needs of local conditions. This knob also serves as a volume control. In normal operation this knob may be set at the position which gives the best combination of volume and selectivity and left in that position. If extreme selectivity or extreme volume are required, this knob may be adjusted accordingly.

The corresponding knob at the lower right-hand corner of the panel provides a second volume control by means of which the strength of signals is increased or decreased as desired in the audio-frequency amplifier itself.

A novel feature of the receiver is the use of power tubes in all stages of amplification. This guards against the possibility of overloading the amplifier tubes, and contributes its share towards perfect tone quality. The power tubes used are of the UX-112 type in the two radio-frequency stages

This new self-contained receiver is operated by plugging in on the AC house lighting lines.

*The Garod Company is licensed under numerous patent applications of Benjamin F. Miessner covering the electrical power features of this receiver.



This power unit supplies all of the operating current for the new Garod receiver. It prevents the hum from the AC lines entering into the receiver and marring the quality of the reproduction.

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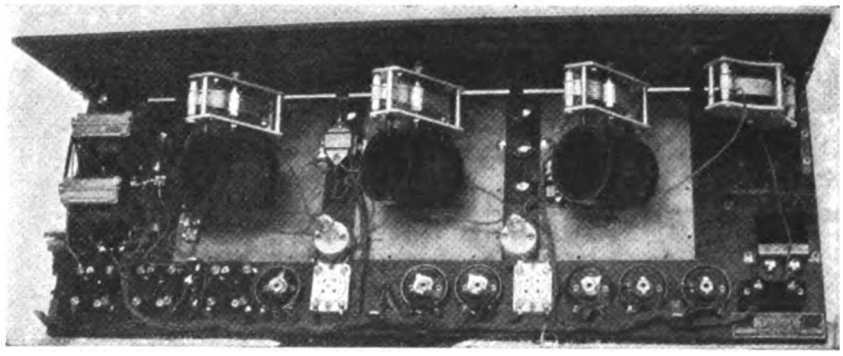

The new Garod receiver employs two stages of neutralized-tuned-radio-frequency amplification, a vacuum-tube detector and two stages of transformer-coupled audio-frequency amplification. Note the partial shielding of the three tuning condensers and the attached coils.

and in the first audio-frequency stage. In the last audio stage a UX-210 type power tube is used. As explained before the filaments of these four tubes are operated from the alternating current.

The detector tube is operated on direct current. The filament current consumption is sufficiently low to permit it to be drawn direct from the plate current supplied by the power-pack.

The Garod receiver will operate on any kind of an antenna. For maximum results a long outdoor antenna, about 100 feet long, is recommended. This is especially helpful in listening in on reception from great distances. For those who are not greatly interested in long-distance reception a shorter outdoor antenna or an indoor antenna will give highly satisfactory results. Or one may go further and dispense with both of these types of antenna and use an ordinary loop antenna; this will give plenty of volume for ordinary use.

The only external equipment required for the operation of this receiver is a loudspeaker. It is recommended that the speaker be of the cone type; it should be the very best obtainable or it will not be capable of maintaining the fine quality of reproduction of which the receiver is capable.*

Maker: Garod Corporation.

*Any additional information regarding this receiver may be obtained by an inquiry addressed to the editor of this department.

A Really Absolute Single-Control Receiver

Name of instrument: The Stewart-Warner Model 355 Receiver.

Usage: For general broadcast reception.

Outstanding features: Absolute single-control operation. Fine tone quality with great volume. Good-looking cabinet.

Description: This receiver presents a striking feature in its simplicity of operation. It is an absolute single-control receiver; this means that all wavelength tuning is accomplished by means of a single knob. On the front panel there are two other control knobs but these have nothing to do with the tuning of the receiver. They simply regulate the volume of sound by varying the current supply from the batteries to the vacuum tubes.

The wavelength tuning knob is located in the center of the panel. Just above it are two small windows through which the wavelength to which the receiver is tuned may be observed. The tuning scale is calibrated both in degrees, as observed through the upper window; and in wavelength, as observed through the lower window.

The left-hand "tone control" knob is provided to vary the "B" battery current to the radio-frequency amplifier tubes; this allows the operator to adjust the volume of sound to any desired degree.

The right-hand knob regulates the filament current to all of the tubes. This knob requires no attention after it is once adjusted, unless the storage battery should become run down below normal.

This receiver is set in a console cabinet. This cabinet is of walnut and is beautifully finished in a warm, shaded brown effect.

The receiving unit is located at the top of this console and is equipped with a metal front panel finished in antique, stippled bronze. The control knobs are set in bronze escutcheon plates which are mounted on the face of the panel.

Just below the receiver is an open grill-work behind which the cone-type loudspeaker is located. Special precautions have been taken, in installing the loudspeaker, to prevent any irregularities in reproduction which might result from enclosing a speaker in a rectangular compartment of a wood cabinet. The main feature in this accomplishment is a bell shaped baffle plate of non-resilient metal which tends to direct the sound out through the open grill.

Below the loudspeaker compartment is another compartment which provides space for all batteries used in conjunction with the receiver. This compartment is equipped with a drop front to permit ready access to the batteries.

In addition to the Model 355 the same receiving unit may be obtained in three other styles of cabinets ranging from a small table-mounting cabinet, just large enough to accommodate the receiver unit, up to a large art-console model.

The circuit employs six tubes. These provide three stages of radio-frequency amplification, a vacuum-tube detector and two stages of transformer-coupled, audio-frequency amplification. The first stage of radio-frequency amplification is untuned; but the input circuits to the second and third radio-frequency amplifier tubes and to the detector tube are tuned, making a total of three tuned circuits. The condensers, by means of which these circuits are tuned, are

(*Continued on page 90*)

This new Stewart-Warner receiver, unlike most single-control sets, has no auxiliary or balancing controls; all the tuning is done with the knob in the center of the panel. The left-hand control is connected in the plate circuit of the radio-frequency tubes and may be used to adjust the volume; the right-hand control regulates the amount of filament current fed to all the tubes and requires no attention.

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SO THAT YOUR ENJOYMENT MIGHT BE UNINTERRUPTED

Today you can be as sure of your B-power supply as you are of your electric lights. No longer need you worry whether your B batteries will run out at the most crucial moment of some national sporting event. No longer need you hesitate to invite the neighbors over to hear the opera for fear that your B-power unit will fail for lack of proper attention.

Raytheon has made possible absolutely reliable B-power that requires no attention. For years Raytheon Engineers studied the application of light socket power to the operation of radio in the home. Eventually the Raytheon rectifying tube was produced, giving an abundance of power, long life (no filament) and complete elimination of all service.

At this point the leading makers of radio equipment took up the task of incorporating the Raytheon rectifier in a complete B-power unit, ready for installation in the home. This has been accomplished with great success by the organizations represented on this page.

Their units, all tested and approved by the Raytheon Laboratories, represent a wide variety of styles and prices. Your dealer will be glad to recommend one best suited for your set. The fact that it is Raytheon-equipped means that unfailing B-power is yours at the touch of a switch.

Raytheon is the heart of reliable radio power.

Raytheon Manufacturing Company
Cambridge, Mass.

RAYTHEON rectifier

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MAYOLIAN RADIO CORP. Bronx, N.Y.
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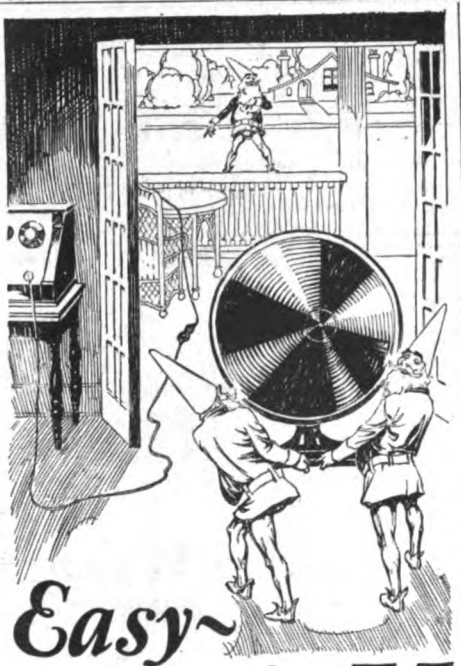
ALL-AMERICAN RADIO CORP. Chicago, Ill.

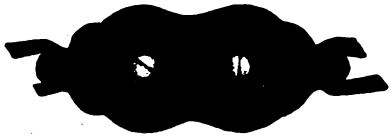
KING ELECTRIC MFG. CO. Buffalo, N.Y.
APCO MANUFACTURING CO. Providence, R.I.
SPARKS-WITHINGTON CO. Jackson, Michigan
J. S. TIMMONS INC. Germantown Phila., Pa.

Organizations Manufacturing B-Power Units RAYTHEON-EQUIPPED



Easy~ with the E-Z

Now you can have radio entertainment in any room, porch or lawn without disturbing your set! The E-Z Extension Connector hooks up to your set easily and quickly, enabling you to carry the loud speaker anywhere. Exclusive tension slot construction assures positive contact.



Connector only - **35c**
with 20 ft. cord—**$1.25** with 35 ft. cord—**$1.75**
" 25 ft. cord— **1.50** " 50 ft. cord— **2.00**

Raytheon Block Condensers

Guaranteed 1000 volt breakdown test. Finest materials and special impregnating compounds embodied in Polymet Block Condensers assure the lasting success of your construction job. Specify Polymet Condensers!

Type 1000-14 Mfd. tapped at 1, 1, 2, 2, 8 . . . . . **$9.50**
Type 1001-.1-C-.1 Mfd. . . **2.00**

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The YES *and* NO MAN

SCOTCHY.—Until you mentioned them, we had never heard of the *Happy-Go-Lucky Girls* at WSBF. * * * Sure, here's their picture. * * * By the way, the young lady on the left is *Alice McDonald* and the one on the right is *Venida Jones*.

JOCKEY KID.—We're an old scandal monger, eh? Well, can you beat that! Come around to this office and you'll get your finger nails pulled out one by one. * * * *Rev. F. S. Lankenan* (KFUO) lectured on "One Hundred Thousand Divorces." * * * KFUO is one of the many gospel voices on the air.

TOMMY LAD.—Did *Amie McPherson's* radio operator jump his wave? My, you're facetious. * * * By the appearance of things, Amie's radio operator belied all of the Red Hot Momma songs. * * * Amie needs a quartz crystal control.

SIR HOBGOBLIN, JR.—The "Chimes of Normandy" was broadcast by WMAQ and WLS on October 22nd. * * * Who's going to be the big chain feature this year? Well, if *Damrosch* does not come within a micro-volt (is that the right term, Professor?) of it, we'll eat a 201-a tube.

JAMES COFFREY.—The *Belmont Orchestra* broadcasts from CNRV at Vancouver, B. C. * * * *John Barnes* was the guest artist of the *A and P Gypsies*. * * * If there was a fight in the studio of WHN on October 18th it was not reported to this office; perhaps it was between Mike and Milli Henry.

BILLY MONDAY.—The Actors Equity would not permit WGBX and WIP to broadcast "The Miracle."

DEARY ME.—These matrimonial queries keep us busy. * * * No, the *Royal Herine* is not the wife of the "big 'ero." * * * Is *Charlie Garland* (announcer at WBBM) as nutty as he sounds when he officiates at the "Nutty" Cluch Broadcast? Any announcer, my friend, is as nutty as he sounds.

AMBITIOUS.—What kind of experience counts most to become a studio manager? * * * Well, floor walking, paper hanging, iron working—any one of these will afford the experience necessary to manage the average American studio. * * * If you want to be real good and rise to the dizzy heights of your profession, get in a few months' experience as a subway guard; that's where you really learn to handle people.

J. H. M.—So you object to our anti-*Brokenshireism!* * * * Well, perhaps we *have* been low and mean but we're not ready to apologize for it. * * * If *Brokenshire* would try to be *Brokenshire*, he'd perform beautifully for, though it's hard to admit, his diction is good; it is only when he attempts to be the nonchalant and witty conversationalist that we lose our temper.

DIXIE.—Why should you inquire concerning the nationality of *Keith McLeod?* * * * He's very much a Scot, although minus the whitewash brush and the kilts. * * * He's five feet five and one-half inches in height and is *not* married. * * * We are told he is thirty-two years old, and he is ambitious only to lead a happy, comfortable life; we don't know that he has a hobby. * * * Your note is pleasant; write again.

HAYDEN B.—What if you do consider it bad taste that *Milton Cross* should have sung "Shake 'Em Up, Susie?" And what makes you think that he should confine himself to the classics or near classics? * * * A singer is seldom known by what he sings; it's how he sings it.

GEORGE B. H.—The *Rev. Robert Hopkin* sermonizes from KOA. * * * Yes, *Eddie Cantor* was on the air recently at WEAF. * * * Little *John Little* is a regular feature at WSM, Nashville, Tenn. * * * *Normal Clark* was the tenor of the South Sea Islanders; his photo is published herewith. * * * *Robert Hauser* is the fresh smarty at WWRL; aside from his being a bumptious simp, it is said that the main part of the transmitter at WWRL is made up out of an old gas range.

ANNABEL.—*John Wells* was the tenor with the *A and P Gypsies;* he made his last appearance on the night of October 4th. * * * You seem to be able to pick out the good ones. * * * Unless we get a little more flattery the next time, you won't get answered!

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I Will Train You At Home To Fill a Big Pay Radio Job

RADIO NEEDS TRAINED MEN!

If you're earning a penny less than $50 a week, clip coupon now. Send for AMAZING FREE BOOK, "Rich Rewards in Radio." Why go along at $25 or $35 or $45 a week, when you could earn $50 to $250 in the same six days, as a Radio Expert? Hundreds of N. R. I. trained men are doing it—why can't you?

Earn $50 to $250 a Week—

RADIO EXPERTS IN BIG DEMAND

Radio needs trained men. Get into this new live-wire profession of quick success. It's the trained man, the Radio Expert, who gets the big jobs of this profession—paying $75, $100, $200 a week and up. Every day N. R. I. trained men are taking good places in the Radio field—men just like you—their only advantage is TRAINING. You can prepare just as they did, by new practical methods. Our tested clear training makes it easy for you. Big Free Book contains all the proof.

"I give you all this apparatus so you can learn quickly at home the Practical Way"

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FREE OF EXTRA COST

You Learn Quickly In Spare Time

So sure am I that I can train you successfully for a better future in this new Big-Pay profession, that I guarantee your training with a money-back bond. Lack of experience or education won't hold you back—common schooling all you need to start. You can stay home, hold your job, and learn quickly and pleasantly in your spare time. My practical, helpful methods enable you to start RIGHT AWAY toward one of the bigger Radio jobs paying $50 to $250 a week. No delay, no losing time from work — no scrimping or scraping to get your training.

Operates WMAQ

"Accepted a position with the Chicago Daily News Station WMAQ. MY INCOME PRACTICALLY DOUBLED, thanks to you. I handle all consultation, also do operating. Your course taught me not only the theoretical but also the practical knowledge that makes my work easy for me." Keith Kimball, Station WMAQ, Chicago, Ill.

You Get All of This

All instruments shown here and others sent to all my students free of extra cost under short time special offer Clip coupon now—find out all about this big unequalled offer while you still have time to take advantage of it. This training is intensely practical—these instruments help you do the practical work. You learn workmanship and get added confidence in your ability.

$70 In One Day For T. M. Wilcox

"I am in business for myself and RECENTLY MADE $70 in ONE DAY. I was an electrician of rich experience, occupying a splendid position as telephone superintendent when I enrolled with you believing it would open up greater opportunities—have not been disappointed. Estimate Radio will be worth tens of thousands of dollars to me in next few years." T. M. Wilcox, Belle Island, Newfoundland.

World Famous Training That "Pays for Itself"

My Radio course World-Famous as the training that "pays for itself." Make more money QUICK when you take up this practical course. Work on millions of antennae, receiving sets, offers you big chance to make spare time cash while you're learning. I'll show you how—teach you the latest "dope," furnish you with business cards, show you how to get the business and make it pay. My students don't wait a year to increase their income—they report QUICK INCREASES as a result of this course—often two or three weeks after starting.

Howard Luce, Friedens, Pa. made $320 in 7 weeks during spare time. D. H. Suitt Newport, Ark., writes, "While taking the course I earned in spare time work about $900." Earl Wright, Omaha, reports making $400 in a short time while taking course—working at Radio in spare time! Sylvester Senso, Kaukauna, Wis., made $500. These records not unusual—these men a few of hundreds.

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We who know the results this practical tested training gets—the increased earnings it has brought to men everywhere—stand behind it all the way with a signed guarantee bond that we give you when you enroll. On completion if you're not entirely satisfied in every way, you get back every cent you've paid us. No strings to this offer—you yourself are the only judge. Get started today! It's your big chance for one of the bigger Radio jobs—mail coupon NOW for my Big FREE BOOK and proof! No obligation.

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Most amazing book on Radio ever written—full of facts and pictures—tells all about the great new Radio field, how we prepare you and help you start. You can do what others have done—GET THIS BOOK. Send coupon today—no obligation.

J. E. SMITH, President
NATIONAL RADIO INSTITUTE
Dept. A-86, Washington, D. C.

MAIL THIS COUPON TODAY

J. E. SMITH, President
NATIONAL RADIO INSTITUTE
Dept. A-86, Washington, D. C.

Dear Mr. Smith—Without obligating me in any way, send me your free book, "Rich Rewards in Radio" and all information about your practical, home-study Radio Course.

Name.....Age.....

Street Address.....

Town.....State.....

EMPLOYMENT SERVICE TO ALL GRADUATES

Originators of Radio Home-Study Training

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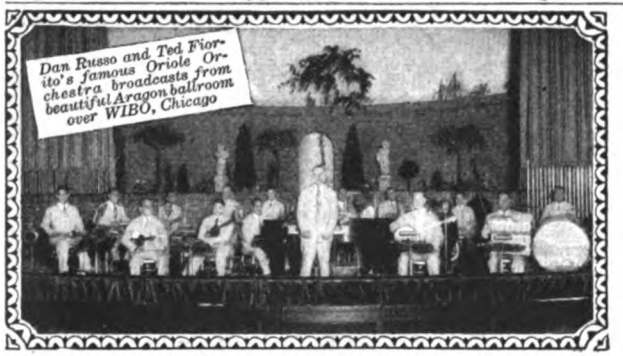

Dan Russo and Ted Fiorito's famous Oriole Orchestra broadcasts from beautiful Aragon ballroom over WIBO, Chicago

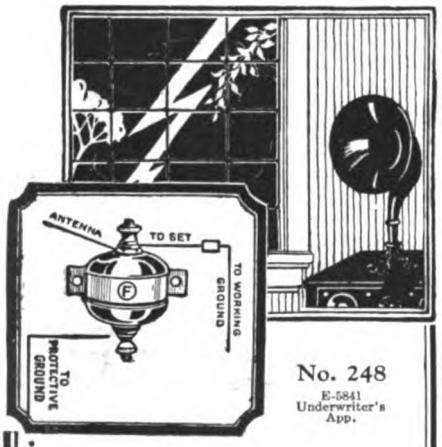
Do you hear *All* of the Orchestra—or *only part?*

WHEN famous orchestras broadcast, do you clearly hear *all* the musicians? Or—through inability of your transformers to amplify low and high notes as evenly as middle tones—are you really only listening to a few of the instruments? Put Jefferson "Concertones" in your set and enjoy the whole orchestra!

Specified in latest circuits because they do not lose, distort or "blast" any audible notes from the lowest (30 cycles) to the highest (10,000 cycles). Ideal for safe, continuous use with power tubes. At your dealer's, $6 each.

JEFFERSON ELECTRIC MFG. CO.
Largest manufacturers of small transformers
508 So. Green St., Chicago, Ill.

Jefferson
Concertone Transformers



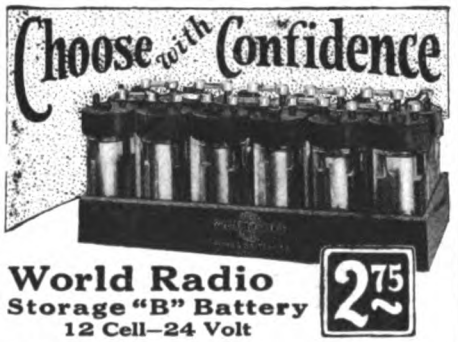
No. 248
E-5841
Underwriter's App.

"Little Joe"
Lightning Arrester

Especially designed for Radio Work. Made of porcelain, small, neat, rugged and serviceable. Can be suspended on antenna or fastened to wall.

Ask Your Dealer

M'f'd by CIRCLE F MFG. CO.
Trenton, New Jersey



World Radio
Storage "B" Battery
12 Cell—24 Volt

2.75

Proved value. Thousands of users find reception almost magical. Clear, true power—instantly and unendingly. Wise economy. Sturdy construction—*Solid Rubber Case* protection. Recharged for almost nothing. Endorsed and listed as standard by famous Radio institutions including Pop. Radio Laboratories, Pop. Sci. Inst. Standards, Radio News Lab., Lefax. Inc., and other Radio authorities. What more need be said? *Extra Offer: 4 Batteries in series (96 volts) $10.50.*

Send No Money Just state number wanted and we will ship same day order is received, by express C. O. D. Pay expressman after examining batteries. 5% discount for cash with order. Remember — you save 50% on World Batteries, so send order to-day.

WORLD BATTERY COMPANY
1219 So. Wabash Ave. Dept. 77 Chicago, Ill.
Makers of the Famous World Radio "A" Storage Battery
Prices: 6-volt, 100 Amp. $10.00; 120 Amp. $12.00; 140 Amp. $13.00.
All equipped with Solid Rubber Case.

Set your radio dials at 288.3 meters for the World Storage Battery Station WSBC. Variety-New Talent-Always Interesting. JERRY SULLIVAN—Director and Announcer—"Chi-CAW-go"

C. L. HOXIE.—Yes, *MacNamee* was sued for twenty-five thousand by a lady in Massachusetts; however, we did not know it was for battery. * * * We have it from WEAF'S publicity department that there is no foundation for the charges. * * * Whatever they are, the case has been put over for a year and the lady in question has had three different lawyers.

BERTIE.—Why does *Edward Hughesing* try to mimic *Norman Brokenshire?* * * * Well, why does a nine year old play he's *Pawnee Bill* or *Jesse James?*

JIMMY WALKER.—The operating staffs of WJZ and WEAF will not be changed by the merger on November 15th. * * * Yes, the *Damrosch* programs are programs what *are* programs. * * * *Whoops*, my dear!

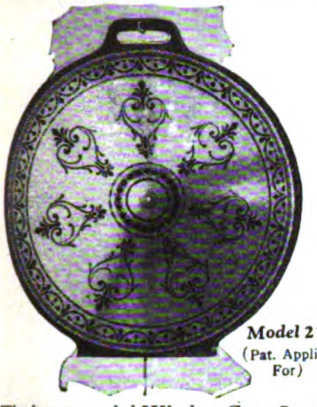
JACK M.—Do we think that *Mr. Wentworth* (WEAF) is a better announcer than *Mr. MacNamee?* * * * Well, that's a matter of personal opinion; given a chance on the big chain, *Wentworth* would, no doubt, become popular. * * * Always remember, sir, that it is the big hook-up and not any special talent on the part of the announcer, that makes these laddies known to the multitudes. * * * We dare say any tongue-tied man with a better knowledge of English than that possessed by the average announcer could not only do a more polished piece of work but he could become famous. * * * The fame of an announcer is measured in watts.

BILL.—For the umpteenth time: *Frances Sebel* is the lyric soprano of the WEAF Opera Co.; here's her photo. * * * Convince the citizens in Syracuse that you play the uke before you come to New York; you might be a wow in the home town but a 32nd degree flop here in New York.

Q AND Q.—What's the "inside" of the *Queen Marie* case at WJZ? * * * One persistent rumor had it that the Queen, after being told that she was about to talk to 20,000,000, developed mental chilblains and made a capricious withdrawal. * * * However, we are not inclined to give credence to this theory; we do admit though that the whole thing has the purple hue of mystery around it.

SUSAN.—Why did *Heywood Broun* write the introduction to *MacNamee's* book? * * * He didn't; *Broun* wrote that stuff for his column and it flattered *MacNamee* so beautifully that he decided to use it as a preface for his book. * * * We've never been flattered, so we don't know what we'd do under the same circumstances. * * * "Black Bottom" a negro spiritual? My, no! It's just a roustabout song. * * * We don't know what the Capitol Family does with all of *Major Bowes* "Thank yous." * * * Perhaps they can them.

Winsdor Wall or Table Type Cone Speaker Amazes Radio World



Model 210
(Pat. Applied For)

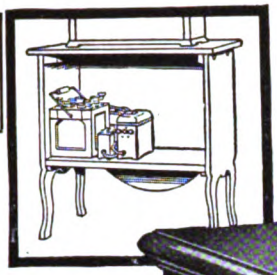
The latest model Windsor Cone Loudspeaker has astonished the world of radio. In convenience, quality of reception, and extremely low price, it far surpasses anything yet offered. The cone is 22 inches in diameter and is mounted on a sounding board which, in turn, is supported by an easel back. It can be hung up on the wall, as in the picture above, or stood upon any flat surface as shown in the picture below. It contains the famous Windsor loudspeaker unit noted for the extreme clarity and fidelity of reproduction.

Model 210
22-inch Cone Loudspeaker with sounding board and easel back.
$15.00
(*West of Rockies* $18)
(Pat. Applied For)

Model 302 (Shown below)
With Moulded Composition Horn Loudspeaker and 18-inch Cone Loudspeaker.

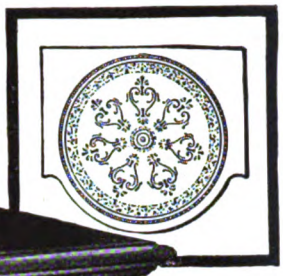
(Pat. Applied For)

In this Windsor Console is combined both the Windsor Moulded Composition Horn Loudspeaker and the 18-in. Windsor Cone Loudspeaker. The top is 30 in. x 17 in. and stands 29 in. high. Plenty of battery and equipment space is provided by large shelf in rear. Price, finished in Mahogany or Walnut **$48.00**
(*West of Rockies*, $55)



Rear view at left shows large compartment with ample space for batteries, battery charger, or battery eliminator, which are entirely concealed from view. Back is open for ventilation of batteries.

At right is shown the Cone Loudspeaker, with its sounding board, which is quickly and easily removable, allowing instant access to all batteries, battery charger, battery eliminator or other equipment and wiring.



(Pat. Applied For

Model 200—with 22-inch Cone Loudspeaker

This Windsor Cone Loudspeaker Console is equipped with a 22-inch Windsor Cone Loudspeaker. Its top is 30" x 17" and is 29" high. The battery shelf provides ample space for batteries, charger, battery eliminator and other equipment.
Beautifully finished in either Mahogany or Walnut.

Model 200
$29
Console with Cone Loudspeaker Ready for Set and Batteries
(*West of Rockies*, $35)

This is the Fastest Selling Line of *Loudspeakers and Loudspeaker Consoles* in the Radio World Today

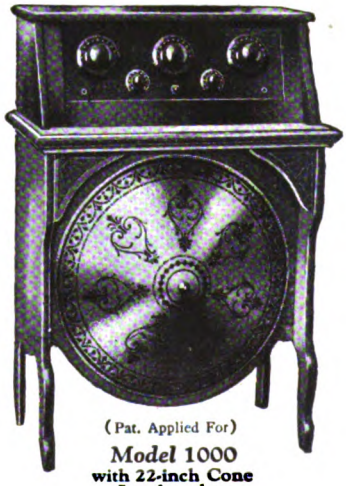
The quality of radio reception made possible by Windsor Cone and Horn Loudspeakers and Loudspeaker Consoles so far surpasses anything heard heretofore that it amazes and delights every radio enthusiast. The Windsor Line is so complete that everyone can find in it a loudspeaker, loudspeaker table, or loudspeaker console exactly to fit their particular needs.

Model 100
with Moulded Composition Horn Loudspeaker or 16-inch Cone Loudspeaker
(Pat. Nov. 18, 1924)

Above is shown a beautiful Windsor Loudspeaker Console, finished in either Walnut or Mahogany, which provides ample space on top for any radio set. The battery shelf beneath will accommodate all necessary equipment. Equipped with either Moulded Composition Horn or 16-inch Cone Loudspeaker. Size: 38 in. x 18 in., and 29 in. high. Price **$40.00**
(*West of Rockies, $42.50*)

To the right is shown the newest Windsor Loudspeaker Console. It is equipped with a 22-inch Cone Loudspeaker and cabinet suitable for 7-inch radio panels up to 26 inches in length. Battery shelf provides ample space for all equipment. Beautifully finished in either Walnut or Mahogany. Price (without receiving set) . . **$44.00**
(*West of Rockies, $52.00*)

Note to Dealers: Write or wire today for details of the highly profitable Windsor line.



(Pat. Applied For)
Model 1000
with 22-inch Cone Loudspeaker

Electrical Department

WINDSOR FURNITURE COMPANY

1414 *Carroll Avenue* • **CHICAGO, ILLINOIS**

Los Angeles Branch—917 Maple Avenue

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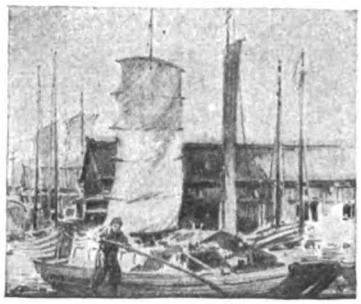
Radio Ops See Foreign Lands



Radio operators on ships have marvelous opportunity for travel and adventure. They earn good pay—in addition to board and sleeping quarters.

Study at home now for a voyage next summer.

Radio Institute of America —world's oldest radio school —offers Home Study Courses that qualify you to pass the U. S. Government Commercial or Amateur License examinations.

Radio Institute conducts a special technicians' course for radio dealers, jobbers and service men. Write for booklet.

RADIO INSTITUTE OF AMERICA
formerly Marconi Institute
Established in 1909
322A Broadway, New York City

Mail coupon for complete description of course.

CUT HERE — A

Radio Institute of America
322A Broadway, New York City

Please send me your free booklet.

☐ I am interested in the radio course which prepares for the Government Commercial, Broadcast or Amateur License.

☐ I am interested in the technicians' course for jobbers, dealers and service men.

Name_____

Address_____

To Start and Stop Your Set Automatically—

(*Continued from page 23*)

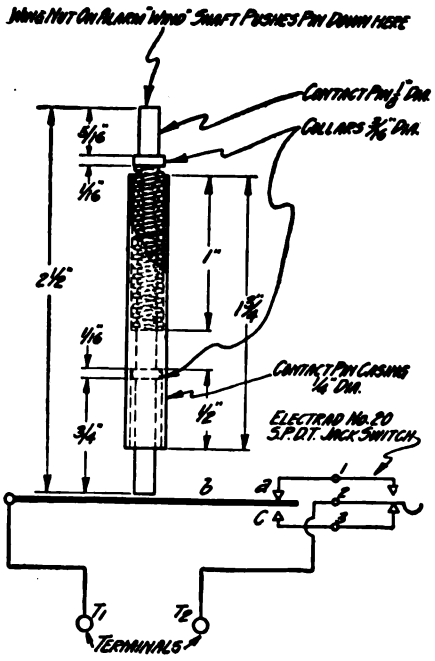
tween the ⅛-inch rod and the walls formed in the ¼-inch rod, by the 3/16-inch hole which extends to a depth of 1 inch from the end. The spring will stop when it comes to the bottom of the 3/16-inch hole, and it should protrude about ⅜-inch from the end of the ¼-inch rod, with the ⅛-inch rod pulled up as far as the lower shoulder will allow.

Now make a shoulder 5/16-inch from the end of the ⅛-inch rod that has the spring. You can make this shoulder in the same manner as you made the other one. This second shoulder is to keep the spring from sliding off the end of the rod.

This contact pin and its casing should be secured in the partition between the upper and lower compartments, in such a manner, that the wing nut on the end of the alarm wind-shaft will engage the upper end of the contact pin when the former rotates, and the lower end of the contact pin should be only 1/32-inch or so above the contact spring B.

HERE IS A LIST OF THE PARTS THAT WERE USED IN THIS UNIT—

1 box 4¾ inches high, 3½ inches wide and 3 inches deep;
1 Electrad, No. 20, single-pole, double-throw jack-switch;
1 New Haven "Tidy Tot," octagon-shaped, alarm clock;
1 piece of brass rod, 1¾ inches long, ¼-inch in diameter;
1 piece of brass rod, 2½ inches long, ⅛-inch in diameter;
2 Eby binding posts.

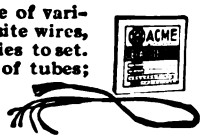


A WORKING DRAWING OF THE CONTACT PIN UNIT

FIGURE 4: *A clear idea of how the action of the alarm clock makes or breaks the circuit may be obtained from this drawing; it also gives the necessary data for constructing the contact pin and its casing.*

ACME
CELATSITE
BATTERY CABLE

—a silk-covered cable of varicolored Flexible Celatsite wires, for connecting batteries to set. Prevents "blowing" of tubes; gives your set an orderly appearance.



Stranded Enameled Antenna

Best outdoor antenna you can buy. 7 strands of enameled copper wire; maximum surface for reception. Prevents corrosion and consequent weak signals.

The Original Celatsite

—a tinned, copper bus bar wire with non-inflammable "spaghetti" covering, for hook-ups. 5 colors; 30-inch lengths.
We also offer the highest grade of "spaghetti" tubing for Nos. 10 to 18 wires. 5 colors; 30-inch lengths.

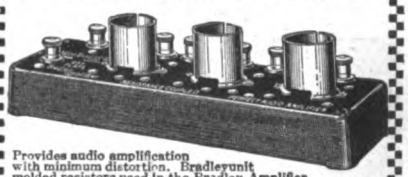
Flexible Celatsite

Flexible, stranded wire for point-to-point and sub-panel wiring. Non-inflammable "spaghetti" covering. In black, yellow, green, red and brown; a color for each circuit. Put up in 25-foot coils.

Send for folder
THE ACME WIRE CO., DEPT. P
NEW HAVEN, CONN.

ACME WIRE
MAKES BETTER RADIO

Bradley-Amplifier
Resistance-Coupled
PERFECT AUDIO AMPLIFIER



Provides audio amplification with minimum distortion. Bradleyunit molded resistors used in the Bradley-Amplifier do not vary with age and are not affected by atmospheric conditions. Can be used to replace transformer amplifiers in standard radio sets with decided increase in tone quality.

Allen-Bradley Co.
Electric Controlling Apparatus
276 Greenfield Avenue Milwaukee, Wis.

Bradleyleak
THE PERFECT GRID LEAK

Provides a noiseless range of grid leak resistance from ¼ to 10 megohms. Assures most effective grid leak resistance value for *all* tubes. Small grid condenser (0.00025) is separate. Metal parts nickel plated. One hole mounting.

Allen-Bradley Co.
Electric Controlling Apparatus
276 Greenfield Avenue Milwaukee, Wis.

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The Quack Doctors of Radio

(*Continued from page 30*)

across our ubiquitous and mysterious "radiation"—truly a word to conjure with in these radio days—the movements of the pendulum being supposed to be directed by these "rays" escaping from the body of the experimenter and flowing down the string to the sensitive weight.

The secret, of course, is the fact that no one, unless by long and arduous training, can hold his hand and fingers absolutely still. There is always a tiny tremble, something that is exaggerated and easily visible in old people, but present and measurable by scientific instruments even in the young and vigorous. This tremble of the supporting fingers sets the weight to swinging; it will set any weight to swinging. The direction to which the weight swings is determined by accident. If messages are spelled out by the letters it is accident also, or else, as with the ouija board, it is a conscious or unconscious direction of the swing by the mind of the operator.

So long as these devices are used by the credulous merely for their own edification and amusement, it is no great business of the radio scientists or of anyone else. The Constitution of the United States guarantees to every man the right to make a fool of himself in his own way; or, if it doesn't, it ought to. But it is some of radio's business when these devices and their like are used to dupe the public and to extract money from them, as such devices are being

Gilliams

A MAGIC PROSPECTOR

Complicated electric devices, supposed to operate by radio, are appearing in place of the old-fashioned forked stick used as a "divining rod."

After Having Served America's Leading Railways for Over 20 Years it is gratifying to know that now, Radios in over 2,000,000 Homes are Protected by BRACH LIGHTNING ARRESTERS

BRACH CONTROLIT

Gives the SET SWITCH Control of Trickle Charger and "B" Substitute — AUTOMATICALLY.

No need, now, to operate three switches every time you turn on or off your set. The Brach CONTROLIT makes this unnecessary by eliminating all extra switches and placing complete control of your power plant and set in the set switch. At the same time it makes any Radio a light socket power-operated set.

Anyone can install a CONTROLIT — no extra wiring or altering is necessary.

See It At Your Dealer's **PRICE $6 in U. S. A.**

Brach Radio Products — 20 years in the lead

L. S. BRACH MFG. CO.

Newark, N. J., U. S. A. **Toronto, Canada**

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AC 12 - $30

From the highest musical note in nature, to the deepest—

Amplion reproduces the whole range—perfectly

TO the world-famous Amplion line of radio reproducers is added the Amplion Cone—time-perfected—clear and mellow in tone—strikingly distinct in the enunciation of the spoken word. In a graceful, two-tone mahogany cabinet, 14"x14"x9".

AMPLION Reproducers, $12 to $45

Ask your dealer for a demonstration or write to us for interesting Amplion Booklet

AMPLION

THE AMPLION CORPORATION OF AMERICA
Suite X, 280 Madison Ave., New York City

KH-27 KITS

SEND YOUR ORDER IN TODAY!

Parts exactly as used by author in the Harkness KH-27 Receiver

1	KH-27 Foundation Unit (including drilled and engraved bakelite front panel, 7" x 26"; drilled bakelite sub-panel 7" x 25", with six tube sockets attached; one pair of bakelite mounting brackets and one 9" condenser shaft.)	
1	Set of K.H. 27 R. F. Transformers (T1, T2, and T3)	
3	K.H. Double Impedance Couplers	
1	K.H. 30 Henry Choke Coil	$49.50
3	Hammarlund 17-plate condensers (Mid-line or S.L.F.)	14.25
1	Yaxley Rheostat, 10 ohms	1.35
1	Yaxley Fixed Resistance, 2 ohms	.15
1	Yaxley Battery Switch, Midget Type	.50
1	Yaxley Pilot Light Bracket	.50
1	Yaxley Open Circuit Jack, Junior Type	.45
1	Yaxley Antenna Switch, Double Circuit, Junior Type	.85
1	Micamold Grid condenser, .00025 M.F. with G.L. mounting	.45
1	Micamold fixed condenser, .001 M.F.	.40
2	Micamold fixed condensers, .002 M.F.	.80
1	Micamold grid leak mounting	.30
1	Micamold grid leak, 2 or 3 megohms	.45
2	Dubilier 1 MFD Condensers	2.50
2	X-L Variodensers, (Type G1) .0001 Max.	3.00
4	Amperites (3 Type 1A and 1 Type 112)	4.40
2	Aristocrat Vernier Port Dials	4.00
11	Eby Binding Posts, engraved as follows: ANT; GND; A BAT +; A BAT −; B BAT −; B DET +; 67 V +; 90 VOLTS+B BAT+; C BAT+; C BAT−	1.65
1	6 Volt Lamp for Pilot Light	.50
	Complete	$86.00

COMPLETE PARTS FOR $38.90 LC JUNIOR POWER PACK

Send Money Order for Immediate Delivery

City Radio Stores

110 West 42nd Street, New York

Downtown Store :: 79 Cortlandt Street

MODEL "C" CHEST

Cabinets in stock—have piano hinge and are 10" deep—grooved front top rail being removable. Illustration shows gold line wood panel to match.

Sizes	Walnut Only	Panel to Match
7x18-10	$15.00	$1.26
7x21-10	17.00	1.47
7x24-10	19.00	1.68
*7x26-10	21.00	1.82
7x30-10	23.00	2.10
*7x28-11	23.00	1.96

*For Madison-Moore Receiver.
*For Victoreen Receiver.

Walnut Infradyne Cabinet

$30.00

LC-27 Cabinets

Mahogany or Walnut with Baseboard

$18.00

The LC-27 cabinets have 25° slope and take 8" x 26" panel. They are full 10" deep back of the panel.

WRITE FOR folder showing complete LC-27 Line and other Radio Furniture.

CORBETT CABINET MFG. COMPANY

St. Marys - - Pennsylvania

used, it is probable, in every fair sized city in the United States today.

It is probably too much to hope that the public can ever be persuaded to cease resorting to practitioners of occult foolery for answers to their questions as to the future or as to their own characters and capabilities. But we can hope that the public will learn what radio can do and what it cannot and that everyone can be taught that mysterious forms of radiation do not exist in nature and cannot be detected as effluvia of the human body or of the human soul.

No Place for "Human Radiation" in the Spectrum of Ether Waves

The long spectrum of the ether waves is now complete, from the radio waves at one end to the new cosmic rays of Dr. Millikin at the other. It is possible that there are longer radio waves than any which we now use, but they will be of similar character and not in the least mysterious. It is possible, too, that there are still shorter waves than those recently found by Dr. Millikin, but these will be merely another variety of gamma rays, as are Dr. Millikin's rays themselves. There are now no gaps in the series and no place for any mysterious "human" radiation, such as the fakers find it so convenient to assume. "Auras" and "eye rays" and "personal emanations" and all the rest of them must go into the dust heap, together with the chromotherapies and the famous electronic reactions.

I am not intending to asperse, however, the recent experiments of Dr. Ferdinando Cazzamali and others in attempting to detect an electromagnetic radiation from the human brain. This work is on a quite different basis. Nerve action is undoubtedly electrical, although the exact mechanism is not yet known. It is probable that nerves and brain cells send out electromagnetic waves when they operate, just as an electric motor does or an electric bell. These waves, however, are merely radio waves like any others. They will have the greatest scientific interest, if we can separate and study them. They may give us important clues about the physiology of nerve action. But no one has suggested that they would have the slightest relation to "personality" or that they would carry any "messages," still less that they would tell us, or anybody, anything about the future or about himself.

Superstitions About Lodestones and Other Magnetic "Charms"

Superstitions die hard. Last year a man was drowned in a small lake in New York State. The body was not found immediately. And so, with the reputed approval of the authorities, some quicksilver was placed in loaves of bread and these were thrown into the lake. It was supposed that an "attrac-

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tion" between the submerged body and the quicksilver would bring the loaves to rest over the spot. This superstition is at least three hundred years old. It did not work last year; so far as anyone knows it never has worked. Yet it is doubtful if it will die, even now.

The chief sale of magnetic iron ore, even today, is for what are called "lucky lodestones" for people to carry in their pockets and to wear on watch chains. When a Chicago publisher died suddenly this spring after having visited some graves of the ancient Mayas in Yucatan even the metropolitan newspapers carried the story that he had succumbed to an "ancient curse."

When these things can happen we dare not call ourselves a scientific nation. It is no wonder that radio is preempted by fortune tellers, and worse. But radio is accomplishing, on the other hand, a great work of popular education. It is teaching more and more people in each community the essential methods and viewpoints of science.

Possibly it is radio that is destined to drive superstition from the world.

How Radio Landed Two Girls On Broadway

ONE of the most romantic episodes of the broadcasting studios deals with the landing of coveted contracts by two obscure choir girls in a suburb of Chicago.

A few months ago these two girls were singing a sacred duet in the story-book-like church. Seated in a rear pew that morning was John Clark, assistant program director of station WHT. So struck was he with the quality of the girls' voices that after the services he sought an introduction to them.

The outcome of the incident was that the two girls, Thora Martens and Dorothy Wilkins, entered the radio service and broadcast songs regularly for WHT.

A little while after this J. J. Shubert was making another production cast for the operetta hit, "The Student Prince." The cast was practically recruited; only two name parts were still open. An appeal was sent out to the Shubert agencies to fill these places.

As Mr. Shubert was writing telegrams in his room at a Chicago hotel, he tuned in station WHT on a receiver that a friend had loaned him. It happened that the two choir girls were on the air, singing one of their best numbers.

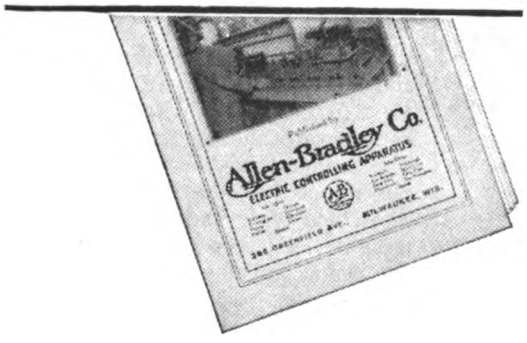
Mr. Shubert sent word to his Chicago director to make arrangements for an immediate audition. The hearing was satisfactory.

And that is how Miss Wilkins and Miss Martens were tendered a forty weeks' contract—which solved the problem of the producer and also gave two of radio's favored artists a foothold on the ladder to stardom.

—BERTHA STREETER

SEND FOR THIS RADIO FOLDER

Contains seven hookups for B-Eliminators published in a prominent radio magazine.

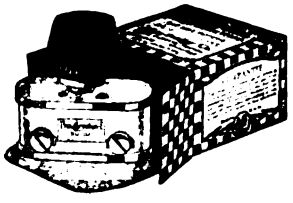


Well-known B-Eliminator Manufacturers who use Bradleyohms

Acme, All-American, American Bosch, Brown & Green, DeWitt-LaFrance, Farrand, Forest Unitron, Grigsby-Grunow-Hinds (Majestic), Kellogg, Philadelphia Storage Battery (Philco), Precision, Radio Receptor; R. A. Rothermel, London; Spartana, Valley, Willard, Wilson.

When You Build a B-Eliminator

Use Bradleyohm-E for the Variable Resistors and Bradleyunit-A for the Fixed Resistors



Bradleyohm-E

For B-eliminator service requiring wide voltage control, Bradleyohm-E is essential. It is an oversize Bradleyohm with sufficient capacity to handle all normal B-eliminator requirements. Be sure to ask for Bradleyohm-E in the checkered carton. Your dealer can get them for you.

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This solid, molded, fixed resistor has no glass or hermetic sealing in its construction. It is a solid unit with silver-plated end caps and is not affected by temperature, moisture and age. By all means, use Bradleyunit-A when you need a fixed resistor

ALWAYS insist that Bradleyohm-E and Bradleyunit-A are included with your B-Eliminator kit, if you want to be assured of perfect voltage control. The leading manufacturers of B-Eliminators have long since adopted these Allen-Bradley variable and fixed resistors as standard equipment for their B-Eliminators. In fact, Bradleyohm-E is used almost as universally as the Raytheon tube, itself.

You cannot afford to risk the use of inferior substitutes for the scientifically treated discs used in Bradleyohm-E. This remarkable variable resistor handles the strenuous requirements of B-Eliminator service without the slightest strain. Ask your dealer for Allen-Bradley Perfect Radio Devices, today.

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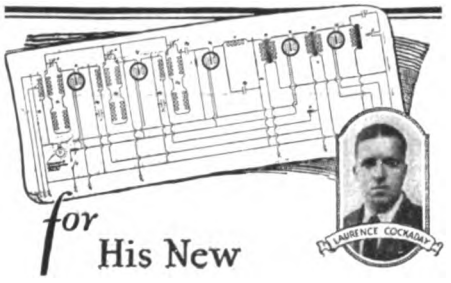

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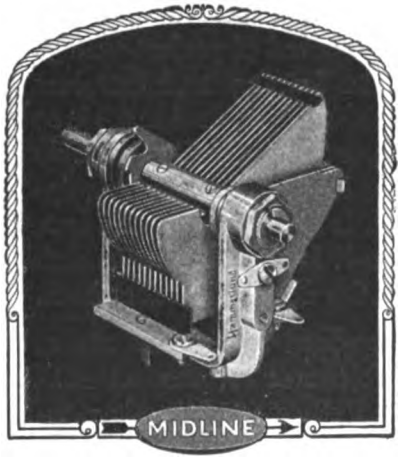


Among the other new circuits of the season for which Hammarland products are specified are:

Lacault "LR4"; St. James Super; Sargeant "Infradyne:" the New Harkness: "Henry - Lyford"; Morison "Varion"; Victoreen Super; Loftin & White; Pacent "Ultimax"; Browning-Drake; Popular Science Monthly "Powerful"; Carborundum; Hammarlund-Roberts "Hi-Q."

We shall be pleased to refer to the proper authorities your inquiries regarding any of these receivers.

HAMMARLUND MFG. CO.

424-438 W. 33rd Street, New York City

For Better Radio **Hammarlund** PRECISION **PRODUCTS**

What Happens When You Tune Your Set

(*Continued from page 32*)

case is that we have no means of detecting, by ear or by instrument, the original ultra-rapid rates of vibration. They have to be rectified somehow before any acoustic instrument can respond, and then we can make use of their intermittences and differences and all of the superposed peculiarities and variations which are inflicted on them by microphonic speech or music, and which are duly reproduced with extraordinary and surprising perfection at the distant station.

This is due to the docility of electrons and the completeness with which they are able to follow in detail every peculiarity even of the most rapid vibrations. The vacuum-tube detector or the crystal can respond to these rates, however rapid; and when they are rectified by these devices, then our mechanical instruments and telephone diaphragms and ears can respond to the rectified peculiarities.

So much for the general principle on which etherial vibrations are brought down to an audible frequency. But now let us go into the matter of oscillations more in detail, and apart from any method of detection.

People have always known that a sounding instrument, when struck or bowed or plucked, was oscillatory. It had the two properties which were necessary for oscillation,—the power of elastic recovery and the power of overshooting the mark; the one being elasticity, the other being inertia.

It is by inertia that a base-ball rises into the air when struck by the bat against the force of gravity, expending its energy as it goes up, and then coming down again; reaching the hand of the fielder with much the same velocity as it started to ascend. Apart from the resistance of the air it descends with exactly the same velocity. This may be regarded as a case of recoil where the restoring force is due to gravity.

If a rubber ball thus thrown up strikes a pavement on its return, it will rebound again, neglecting the effects of air resistance and friction, to the same height to which it originally went. Actually it will rebound up to a smaller height, due to this air friction and it can go on rebounding with many oscillations till friction wipes out its energy and turns it into an imperceptible amount of heat.

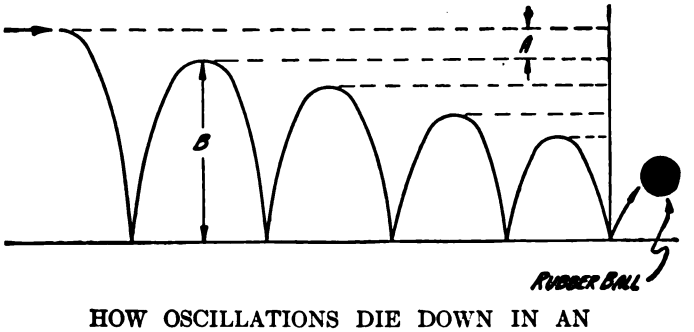
The same thing happens more easily in a pendulum. When you deflect the pendulum, the bob is raised against gravity. It falls back or recoils when you let it go, and returns to its original position with a definite velocity, and not only a definite velocity but a definite momentum; for the bob has inertia or mass.

Accordingly, it does not stay in its original position: it overshoots the mark, and rises on the other side to practically the same height as that to which it was raised when let go. It then returns again, once more overshoots its equilibrium position by reason of inertia, and so goes on oscillating for a long time.

A spring clamped in a vise will do the same thing. It is instructive to clamp a vertical wooden lath in a vise and fix a lump of lead on the top of it. If that load is now pulled aside, the lath will oscillate in a leisurely manner, much like an inverted pendulum.

The restoring force which causes the recoil is now not gravity but elasticity, and the inertia of the leaden ball is what prolongs the oscillations, and also regulates the frequency of vibration. The bigger the load the slower the vibration: the stiffer the spring the quicker the vibration. If the lath is shortened it vibrates more rapidly: if the load is diminished it vibrates more rapidly.

The two things, elasticity and inertia, are necessary for all vibration, and their ratio determines the rate of vibration. If you vary both in the proper proportions you can keep the rate of vibrations the same.



HOW OSCILLATIONS DIE DOWN IN AN ELECTRICAL CIRCUIT

When a rubber ball falls and strikes the ground it only rises to the height "B" on the rebound. This height is less than the original height by the amount A; resistance in various forms kept the ball from rising as high as before. The third, fourth and fifth bounces are likewise reduced by resistance, so that each one is less than the former by approximately the same amount A, until the bounces die out entirely. This is a simple analogy to show the way in which resistance in a circuit causes oscillations to die out gradually until they cease entirely.

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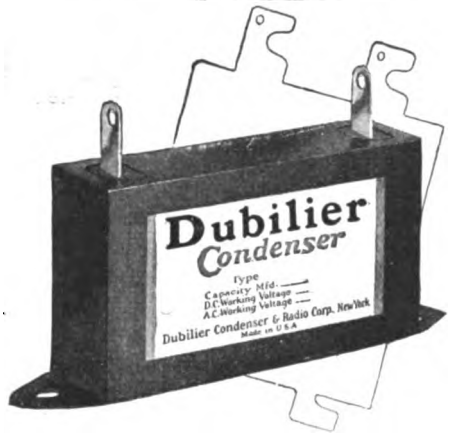
The Passing of "By-Pass" condensers-



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"By-Pass" was the name originally given to small paper condensers by Dubilier. This name described their functions—such as shunting radio frequency currents around high resistances, and their use in amplifier circuits.

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In the new Type 907, Dubilier has made a compact all-purpose condenser with a *working voltage** of 160 volts D.C. With improved soldering lug terminals and mounting feet, Type 907 will give more efficient service in smaller space for every purpose for which the old "By-Pass" type of condenser has been used.

For long life at high voltages insist on Dubilier Paper Condensers.

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*Working voltage means more than "test voltage." It is the voltage at which a condenser may be safely used in continuous operation.

A short spring with a big load can vibrate at the same rate as a long spring with a small load. If the load is too small, the vibrations die rapidly away; they have not enough energy. A pendulum with a heavy bob continues to swing longer than one with a light bob, for the resistance of the air has less effect upon it, or rather it has so much energy to begin with that it can overcome the resistance of the air longer.

The spring experiment is more instructive than the pendulum experiment from our present point of view; because increasing the load of an ordinary pendulum does not affect its time of swing. The restoring force, which is the weight in the case of a pendulum, is increased in exactly the same proportion as the inertia or mass is increased. Accordingly, all pendulums of the same length vibrate at the same pace, though the massive ones continue longer in vibration.

This is why a pendulum is so useful as a timekeeper, and the isochronism of a pendulum was used by Newton to prove that weight and mass were proportional,—a remarkable though as yet unexplained fact.

This singular simplification does not occur when we use elasticity as the restoring force. In the spring the two properties are separated; the extra load is independent of the stiffness of the spring; accordingly we can vary both separately, and show that the time of vibration varies directly, as the square root of the stiffness and inversely as the square root of the load. Quadrupling the load, keeping everything else the same, will double the time-period of swing, or cut the frequency of vibration in half.

Every musical instrument depends on the combination of these two properties: elasticity and inertia; and in the case of a reed instrument, like a harmonium or a concertina, the principles are applied very much as already described. The shorter and stiffer the reed, the higher the note or, in other words, the more rapid the vibration.

The reed need not be actually loaded because it has some inertia of its own. If it is loaded, the pitch is lowered.

If, on the other hand, the tip of the reed is filed away, it vibrates a little quicker. If the reed were filed lower down, at the part which bends and which therefore regulates the elasticity, it will vibrate slower. Thus by a file it is possible to tune a reed to any desired note.

In a stringed instrument, like a harp, a piano, or a violin, the recoil is due, not to the elasticity of the material, but to the stretching force or tension which brings the string back when struck or plucked or bowed; its own inertia being depended on for carrying it past the equilibrium position and maintaining the oscillation for a certain time.

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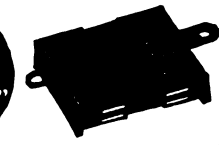

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The rate of vibration then depends directly on the stretching force and inversely on the inertia of the string. It also depends on the length of the string. Accordingly, a string may be tuned either by altering the stretching force by twisting a peg to which it is fixed, or by shortening it, as in a violin, by the pressure of the fingers.

Every kind of matter, even air, has some inertia. The elastic recoil of air depends on its pressure, and its inertia depends on its density.

The ratio of the pressure to the density determines the rate of vibration of the air in an organ pipe of given length. The ratio of pressure to density varies with temperature, provided we reckon the temperature from absolute zero.

Accordingly, as a room gets warmer, the pitch of the pipes is raised, and an organ may go slightly out of tune with respect to the other instruments, the strings of an orchestra, for example, so that they may have to adapt themselves to the organ's new pitch. The air in an organ pipe has the two properties elasticity and density essential to vibration; though, as the inertia is small, the vibrations rapidly die away, and have to be maintained by blowing. Indeed the vibrations of all musical instruments except tuning forks die away rapidly, and if they do not die away rapidly enough for musical purposes, i.e. for the desired succession of notes in melody, they are purposely damped. In this case the friction has to be increased.

Vibrations die away for two reasons, first because of friction, second because of the energy emitted as sound. When a vibrating body emits sound, it does so at the expense of its own energy. A silent tuning fork continues to vibrate longer than one which is mounted on a sounding-board

In electrical oscillations all this is true and has practical applications. Inductance takes the place of inertia; capacity, or rather its reciprocal, which has been called "stiffness," takes the place of elasticity. The dying away of oscillations is determined partly by the emission of waves, partly by electrical resistance. Sometimes one of these causes is the more prominent, sometimes the other; the first cause is useful, the second is waste. Resonance can be excited by the first, and can occur in spite of the second.

Where you get great distance on small power, you usually get great interference.

* *

Trans-oceanic radio stations use antennas three miles long.

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ONE in every seven families in the state of Victoria, Australia, has a receiving set.

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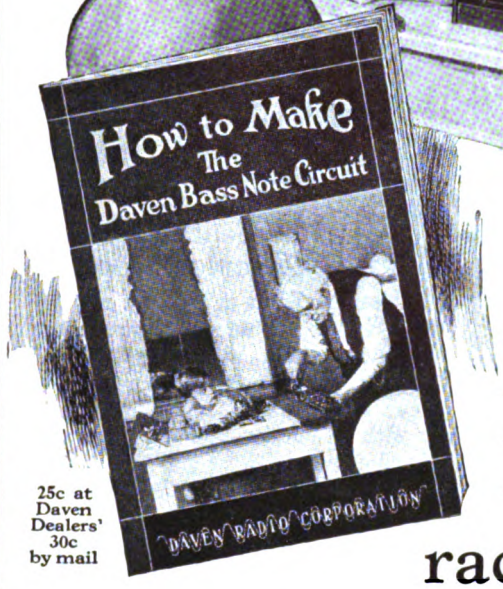

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THE Daven Bass Note Set—the "hook-up" that all radio fandom is talking about—and building! The pure-tone circuit that will be the feature of next year's leading factory-built sets. The set that will open your eyes—and ears!—to the new possibilities in radio! The set that will be the talk—the envy—the *model*—of your neighborhood!

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IF you are not interested in set building, but want the new completeness of reception, the easy 2-dial tuning, the sharp selectiveness that the Bass Note Circuit brings, you will be interested to know that we have bought a controlling interest in the Port Manufacturing Company of Newark. Write for Free Folder showing and describing complete Daven Bass Note Sets. Address,

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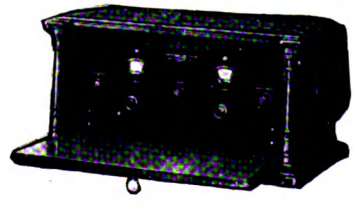

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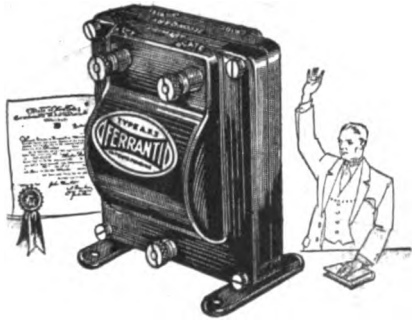

All the Truth and nothing but the Truth!

If your set gives you poor quality, it is telling lies about the sending station. If it fails to transmit those low bass notes, it is concealing part of the truth.

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Ferranti Transformers can probably modernize that old set of yours or improve the reception of even a new one. Your dealer can help you install one or two.

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High amplification ratio with flat curve.

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No Better Transformer Is Available At Any Price

WHAT READERS ASK

CONDUCTED BY DAVID LAY

IN justice to our regular subscribers a nominal fee of $1.00 per question is charged to non-subscribers to cover the cost of this service, and this sum must be inclosed with the letter of inquiry. Subscribers' inquiries should be limited to one question or one subject.

A Volume Control for a Resistance-Coupled Amplifier

QUESTION: What is the best method of varying the volume in a three-stage resistance-coupled amplifier? I also want a wiring diagram that shows the proper connections for such an amplifier with an output filter and a volume control device.

—J. J. HOWARD

ANSWER: Figure 1 shows the circuit diagram for the amplifier with the features that you require incorporated in it. The filter unit consists of a high-inductance choke of 30-100 henrys and a high-voltage condenser of about 4 mfds. This is shown connected to the last stage of resistance-coupled amplification; a "C" battery is also included on this same stage. The dotted lines outline a high-resistance Electrad potentiometer that has been made especially for this purpose.

* *

How to Stop the Howl from a Loudspeaker

QUESTION: I have a good set that furnishes fine tone quality and good reception in every way, except that I have to place my loudspeaker a long distance away from my receiver by means of a 20-foot extension cord. At night I would like to have the loudspeaker close to the set so that I may tune in for distance without awakening the family, but I find that I cannot do this on account of the loud squawk that is set up. There seems to be some kind of interference between the loudspeaker and the tubes of the set.

If I hold the tubes with my hands, the squawk stops but as soon as I let go, it starts up again. Can you suggest a remedy for this?

—GEORGE A. BORSET

ANSWER: The phenomena that you have noticed is caused by a mechanical vibration of the tubes from the audio-frequency sound wave that emanates from the loudspeaker.

A remedy for this would be to use a vibrationless type of socket for the detector tube. If this does not eliminate all of your trouble, replace all the tube sockets with vibrationless sockets and you will be sure to get rid of this troublesome noise.

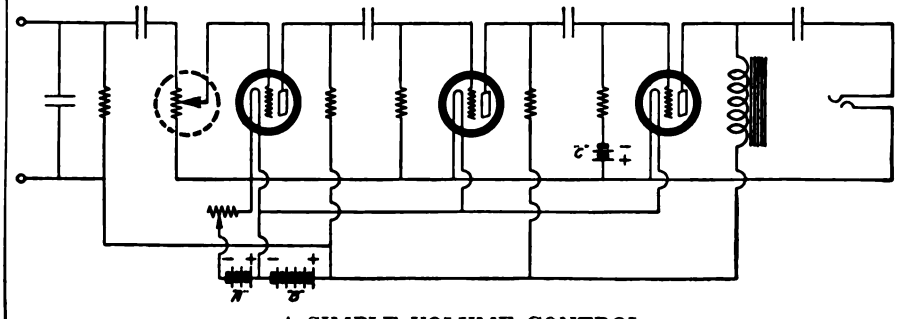
* *

What Batteries Shall I Use In My Set?

QUESTION: What type of "B" batteries would you recommend for use in a six-tube set that employs a 171-type tube in the last stage with five, regular 201-a tubes in the radio-frequency amplifier, detector and first audio-frequency stage?

—RICHARD BARTON

ANSWER: You should use a heavy duty type of 45-volt "B" battery of any one of the approved standard makes as advertised in POPULAR RADIO. A smaller type of battery would not be satisfactory as the current consumption would be too high and the cells would run down in too short a time.



A SIMPLE VOLUME CONTROL

FIGURE 1: *This diagram shows the proper connections for a resistance-coupled amplifier with an output filter and an efficient volume control. The control is outlined by the dotted line.*

The new Balkite Combination- with your "A" battery

U. S. PATENT, OCT. 12, 1926

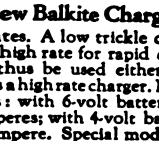
it supplies all radio power automatically from the light socket

3 New Balkite "B"s

Eliminate "B" batteries and supply "B" current from the light socket. Three models. Balkite "B"-W at $27.50 for sets of 5 tubes or less requiring 67 to 90 volts. Balkite "B"-X for sets of 8 tubes or less; capacity 30 milliamperes at 135 volts—$42. Balkite "B"-Y for any radio set; capacity 40 milliamperes at 150 volts—$69. (In Canada: "B"-W $39; "B"-X $59.50; "B"-Y $96.)

The New Balkite Charger

Has two rates. A low trickle charge rate and a high rate for rapid charging. Can thus be used either as a trickle or as a high rate charger. Noiseless. Rates: with 6-volt battery, 2.5 and .5 amperes; with 4-volt battery, .8 and .2 ampere. Special model for 25-40 cycles. Price $19.50. West of Rockies $20. (In Canada $27.50.)



Balkite Trickle Charger $10

MODEL K. With 6-volt "A" batteries can be left on continuous charge thus automatically keeping the battery at full power. With 4-volt batteries can be used as an intermittent charger. Or as a trickle charger if a resistance is added. Rate .5 ampere. Price $10. West of Rockies $10.50. (In Canada $15.)

All Balkite Units operate from 110-120 volt, 50-60 cycle AC. The Balkite Charger is also made in 25-40 cycle model.

Now you can operate your radio set from the light socket. Merely by adding the new Balkite Combination Radio Power Unit. Once connected to your "A" battery and set and plugged into the light socket, it *supplies automatic power to both circuits.* You need not even turn it off and on, for it is controlled by the filament switch already on your set and is entirely automatic in operation. It will give you a constant quality of reception that cannot be secured in any other way.

Balkite Combination can be installed in a few minutes, either near the set or in a remote location. Like all Balkite Radio Power Units it has no tubes, nothing to replace or renew, is a permanent piece of equipment, and is built to conform with the standards of the Underwriters' Laboratories. It is noiseless in operation. It will serve any set now using either 4 or 6-volt "A" batteries and requiring up to 30 milliamperes at 135 volts of "B" current—any set of 8 tubes or less, including power tubes.

Add Balkite Combination to your radio set and know the pleasure and convenience of owning a receiver always ready to operate at full power. Price $59.50. [$83 in Canada.] Ask your dealer. *Fansteel Products Company, Inc., North Chicago, Illinois.*

Listen to the Balkite Radio Symphony Concerts with Walter Damrosch and the New York Symphony Balkite Hour Saturday Nights 9 P. M. Eastern (8 P. M. Central) Standard Time, over WEAF, WEEI, WGR, WFI, WCAE, WSAI, WTAM, WWJ, WGN, WCCO, KSD, WDAF, WOC.

FANSTEEL

Balkite Radio Power Units

THE BALKITE LINE OF ELECTROLYTIC DEVICES IS PROTECTED BY DUMAS EDGAR W. ENGLE U. S. REISSUE PATENT NO. 16,436, DATED OCT. 12, 1926

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MAR-CO controls, specified in the construction of the L. C. 27, add searching action — free from backlash — as well as the distinguished appearance that characterizes a 1927 model set.

MAR·CO
Illuminated **Controls**

BROADCAST LISTENERS

The POPULAR RADIO ATLAS and LOG will give you a list of all the NEW Broadcasting Stations with wavelengths and other necessary information

A Complete Atlas and Station Log

The "POPULAR RADIO International Radio Atlas and Log" will supply you with full information regarding broadcasting stations of the United States and Canada.

This most useful and practical Atlas consists of 16 pages, size 12" x 15", printed on good paper, from clear type in two colors and contains a complete series of double page maps, including—The World—The United States—Canada—North and South America, showing location of principal broadcasting, leading commercial and governmental radio stations.

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You may have a copy of the "POPULAR RADIO International Radio Atlas and Log" free, with POPULAR RADIO for (8) eight months.

For Only $2.00

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If you are a subscriber to POPULAR RADIO your subscription will be extended eight months.

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FIXED CONDENSERS

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All Micamold products are moulded in genuine Bakelite. Values and capacities guaranteed permanent.

Manufacturers use Micamold Resistors and Condensers to the exclusion of all others, for once inserted in the set, resistor and condenser trouble is forever eliminated.

Micamold Products are indestructible. They are not harmed by heat or cold and may if the builder desire, be soldered right into the set.

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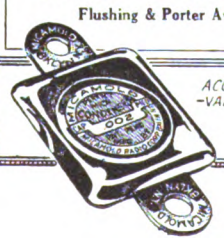
Flushing & Porter Ave., Brooklyn, N. Y.



ACCURACY GUARANTEED
-VALUES REMAIN CONSTANT

MOULDED UNDER PRESSURE OF 50 TONS
50 TONS

A Simple One-tube Set That Will Not Howl

QUESTION: Can you give me a simple circuit diagram that shows a hook-up for a variocoupler and a variable condenser to be used with one tube in a non-regenerative circuit for local reception on the headphones?

I want a circuit that will not squeal under any circumstances. At present I have a crystal set that gives very satisfactory service on the two stations that I listen to, but I would like to get a little more volume.

—E. B. T.

ANSWER: The hook-up that you require is shown in Figure 2.

You will need beside your variocoupler and your variable condenser, the following instruments—

1 grid-leak and condenser combination;
1 tube socket;
1 rheostat, 20 ohms;
1 single-circuit jack;
1 UX-199 tube;
3 dry-cell "A" batteries, 1½ volts each;
1 "B" battery, 45 volts;
Connection wire and 6 binding posts.

You may be confident that this simple circuit will not radiate nor cause interference to your neighbors no matter how close they are located. This small set, when finished, should give you exceptionally clear and pure reproduction from all the local stations, if a good pair of high-resistance telephones are used with it.

* *

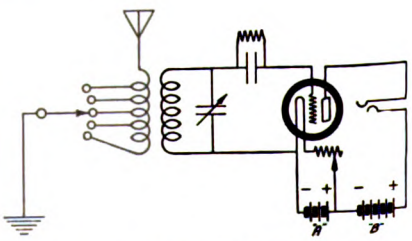
What Is an "Output Filter"?

QUESTION: I have often read in your magazine about output filters for loudspeakers but I do not quite understand what they are for or what they do. Will you give me a brief description of this piece of apparatus?

—JOHN BALL

ANSWER: The output filter, or speaker filter as it is sometimes called, consists of a high-inductance choke coil for feeding the high-voltage, direct current to the plate of the last tube in a receiver, usually a power tube. Combined with this is a large condenser, placed in parallel with the plate circuit and in series with the loudspeaker itself. This condenser allows the audio-frequency currents to flow through the loudspeaker to prevent a flow of direct current through the same instrument, thus protecting the windings of the speaker from the high voltage.

A still further use of the filter is to place a high impedance in the plate circuit of the tube so that the tube will operate on a more favorable characteristic than if the low-impedance winding of the loudspeaker were directly in the plate circuit of the tube.



AN EFFICIENT ONE-TUBE SET

FIGURE 2: *The wiring diagram for a one-tube non-regenerative receiver that will not radiate and that will give good clear reception from nearby stations.*

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YAXLEY
APPROVED RADIO PRODUCTS

Automatic Power Control

No more inserting and removing plugs from your light socket—no more turning several switches every time you use your radio set when you have a Yaxley Automatic Power Control.

The Power Control automatically takes care of your B-eliminator, trickle charger and A battery when you turn your set on or off. It does this without fail. No danger of forgetting to turn one switch and find your A battery run down or your tubes needlessly burning

The Power Control cuts in the B-eliminator and A battery, cutting out the trickle charger when the set is turned on. The B-eliminator and A battery are cut out and the trickle charger cut in when your set is turned off.

No. 444 Automatic Power Control, Series Type—for use with sets with tubes having a current draw equal to or greater than 6 U.V.-199 tubes..... Each, $5.00

No. 445 Automatic Power Control, Multiple Type—for use with sets having tubes with a current draw lower than that equal to 6 U.V.-199 tubes. Each, $6.00

Order a Power Control from your dealer today. If he cannot supply you, send his name with your order

Yaxley parts have been approved for the K-H 27

Yaxley Mfg. Co.
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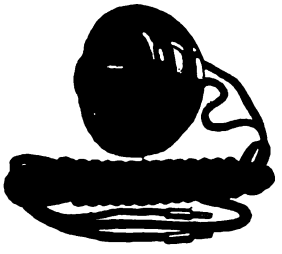
Wonderful Volume with Clearness
AMPL-TONE



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Phonograph makers have spent years perfecting the acoustic properties of their phonographs. Use an AMPL-TONE Unit and make a real Loud Speaker in an instant or use it in your horn and get better results.

After all, speakers are as good as their unit. We make a real unit at a real price. Money gladly returned if you are not entirely satisfied.

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DERBY, CONN.
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Please send me an AMPL-TONE Unit for which I enclose $3.00.

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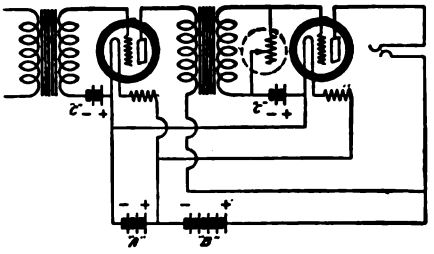


AN AUDIO VOLUME CONTROL

FIGURE 3: *A 50,000-ohm variable resistance connected across the secondary of the second transformer will provide an adequate volume control for a two-stage audio-amplifier.*

A Volume Control For a Two-Stage Amplifier

QUESTION: Please show me how to cut down the volume on a two-stage, audio-frequency amplifier? I have a set that employs good quality transformers and it gives exceptionally loud volume, too much for ordinary home use. I want a method of cutting down the volume that will not interfere with the quality of reproduction that I now get.

—GEORGE BERNEY

ANSWER: In Figure 3 you will find a hook-up that shows the amplifier equipped with the proper "C" batteries and a 50,000-ohm variable resistance that is used as a volume control. This resistance is shown in the diagram in a dotted circle connected directly across the secondary of the second transformer.

* *

How Many Amplifier Tubes Should I Use?

QUESTION: How many stages of resistance-coupled amplification should I use to get full loudspeaker volume? How many stages of impedance-coupled amplification would give me the same results and how many stages of transformer coupling would be approximately the same?

—RANDOLPH CHICKERING

ANSWER: You can use three stages of resistance coupling or three stages of impedance coupling with about the same volume as you will get from two stages of transformer-coupled amplification.

* *

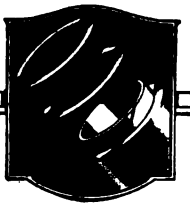
How to Make an "A" Battery Voltage Reading

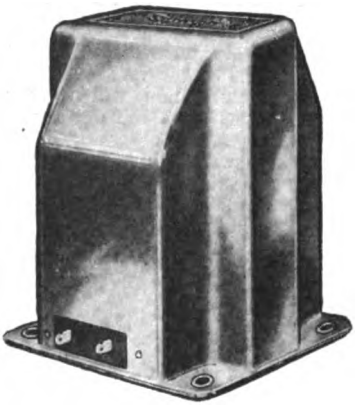
QUESTION: How may I use a battery voltmeter in the Browning-Drake set for reading the voltage of the "A" battery?

—LINTON OWENS

ANSWER: We suggest that you install two pin jacks on the panel in a suitable position and connect them directly across the "A" battery binding post of the receiver. Then you can use one of the new type of voltmeters that is equipped to fit the pin-type jacks. To make a reading, the voltmeter pins are inserted on these jacks and a reading taken; after this the voltmeter may be taken off the panel again and put away in the drawer for safekeeping until another check is desired on the "A" battery voltage.

A number of manufacturers of electrical instruments are now making this type of voltmeter.





Samson Dual Impedance

gives fine tone quality at low cost

Majestic Music, real and rich in deep bass and high treble notes, will instantly flow from your radio receiver if you simply replace average audio transformers by inexpensive Samson Dual Impedances.

This latest development for fine tone quality, designed by Harold Donle, may be used where double impedance systems of amplification are recommended. These units are self contained. No extra parts to buy. Price $5.00 each.

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Get Your Complete Parts for All the Newest Circuits Here

In every issue of Popular Radio and other radio magazines you will find the newest circuits of the world's greatest radio engineers. You will want to build these sets from the parts listed. BARAWIK service keeps up to date on all the new wrinkles. We have the parts used for all these new circuits, complete, ready to ship you the instant your order arrives. Take advantage of this unequalled service. Get what you want—quick—at a big saving. No order too large or too small for us. 300,000 fans swear by BARAWIK service. We can please you, too.

Short Wave Equipment—Special Amateur Section

The Barawik line features this season a special Amateur Department in charge of F. J. Marco, owner of station 9ZA, a nationally famous radio engineer and an authority on amateur work. It presents the latest in short wave equipment, transmitting and receiving supplies and everything necessary for the amateur and experimenter. Special attention has been given to short-wave kits including the B-T, Aero Coil, Silver Marshall R.E.L., etc. It will pay you to get our new **Guide** at once.

Radio's Newest at Rock-Bottom Prices

The new 1927 edition of the Barawik Catalog and Guide gives a comprehensive listing of the radio sets, parts, kits, supplies and accessories necessary in radio. This new **Guide** contains over 6,000 items of radio's newest developments, everything that a real fan will need from the complete factory-built set to the smallest screw, including labor-saving devices, tools, power supply units, amplifier equipment, etc. Standard equipment of the best known manufacturers at tremendous savings.

Besides the complete radio and amateur line there is shown a selection of electrical goods, household appliances, auto accessories and articles necessary in the home—all at a big saving in price.

Write today for your free copy of the 164-page guide. Also please include name of other fans. Mail the handy coupon NOW.

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How to Get Rid of Separate Tube Rheostats

QUESTION: Is it possible to do away with the use of separate rheostats for each tube in my five-tube neutrodyne receiver? Can I use a resistance device that will take care of all the tubes, so that I will always get maximum results if my storage battery is kept up to proper charge?

—JAMES R. MILL

ANSWER: You may incorporate either one of two schemes in your set. The first is the use of separate filament controls, such as the Brachstat, the Elkay resistance or the Amperite. If you are using five ¼-ampere tubes you will need five ¼-ampere adjustors. The second scheme is the use of one adjustor for all of the five tubes; in this case, it would be necessary to employ a control adjustor that would pass 1¼ amperes.

* *

Power Tubes for the Browning-Drake Receiver

QUESTION: Can I use a UX-112 tube in the Browning-Drake receiver (described in the August, 1926, issue of POPULAR RADIO) in place of the UX-171 tube? Why was the 171 tube used by the designer instead of the UX-112?

—GEORGE RUSSELL

ANSWER: You can use a UX-112 tube in this circuit with very good results. The UX-171 tube was recommended because it gives greater volume without distortion than is obtainable with the UX-112. The latter tube, however, will give plenty of volume for ordinary home use.

* *

What "C" Batteries Shall I Use?

QUESTION: How many volts of "C" battery should I use on a 112-type power tube with 135-volts on the plate?

—G. PERKINS

ANSWER: Use a "C" battery of approximately 9 volts for this type of tube, if it is placed in the last stage of an audio-frequency amplifier. This is the voltage that will give you the least variation of reflection in a milliameter connected in the plate circuit of this tube when it is in operation as an audio-frequency amplifier.

* *

How to Cut Out Radiation

QUESTION: I have a three-circuit tuner and I understand that this type of set is liable to radiate and cause interference to my neighbors. In fact, one of my friends who lives in the next house demonstrated this clearly to me. I want to know what kind of unit I can use ahead of my present set to eliminate this trouble?

—V. REUSCHER

ANSWER: We suggest that you use one stage of neutralized radio-frequency amplification ahead of your present receiver. This will employ one more vacuum tube than you now use and it will add considerably to the range and selectivity of the set as well as cut out any objectionable radiation. A complete unit, such as the Penetrola, is recommended.

Double Enjoyment
Volume with Perfect Tone

Why sacrifice the excellent reproducing qualities of a set by the use of an inferior speaker. Proper design and construction has produced in the BURNS Speaker a most satisfying instrument. It is possible to reproduce with amazing exactness every note of music and inflection of the voice that the set is capable of picking up. A trial will convince.

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500 Words

(Continued from page 21)

is usually pronounced "áirial," when the dictionaries plainly give "a-êar-i-al."

The loudspeaker was on the brink of becoming "horn" when the advent of the "cone" intervened.

A few mistakes in terms have been accepted and given the status of good form simply through continued usage—another interesting case for the philologist. "Broadcast," in the past tense, is an outstanding example.

During the early days, every self-respecting announcer said "broadcasted." But the type of announcer who said "sang" for "sung," persisted in taking the short-cut "broadcast," till today, through usage, "This evening's program has been broadcast" is universally accepted as good form.

Most of these terms devised by the newcomer, though patent incongruities, are harmless. People know what they mean at least, and correctness is relative, most of all in speech. But there are some which cannot escape the classification of outright mistakes, of which a common use of wavelength is the most conspicuous.

Too often this is confused with power, as in the case of "Yes, WJZ comes in strong. They've got 455 meters." The old-timer, in fact anyone familiar with radio, will explain that wavelength is not a measure of power; that is simply represents the frequency of the broadcast wave. So here is an error in fact as well as terminology.

There is a commercial aspect to popular usage as it affects the radio vocabulary too. The word superheterodyne has, for example, been contracted to "super" in everyday speech, to such an extent that manufacturers are confronted with a real problem in keeping it from being confused with other receivers, not in fact superheterodynes, which employ the term "super" in their names. If the practice continues there is even reason to believe that these manufacturers will be forced to adopt a new name that they can protect legally.

So the junking of the radio vocabulary so sacred to the old-timer, and its replacement with a substitute jargon devised by the lay newcomer, goes on. Just now it seems pertinent to wonder what will ultimately become of such terms as "electrolyte," "rectifier," and "oscillator," when they have been put through the mill.

The lack of a common language is retarding the growth of radio in the Mukden region of China.

* *

A hotel in Shaftesbury, England has been named "Listen Inn."

* *

Australia averages about two radio sets to every 100 of population.

A complete metallic shield forms the back of the Eby Dial and minimizes the effect of body capacity. Removing hand does not detune receiver.

EBY SHIELDED DIAL

Even the best instruments are inefficient unless properly controlled and accurately set. This sensitive, finely constructed indicating device is scientifically designed for exact micrometer tuning.

Hairline accuracy is obtained by smooth positive friction drive, eliminating all back lash. No gears or washers.

The Eby Shielded Dial operates any type condenser, clockwise and counter-clockwise. Graduated from 0 to 100 and 100 to 0. Easy to mount by drilling one additional hole.

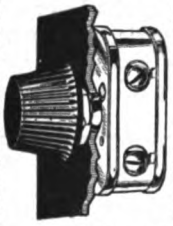
List Price $2.50

MEMBER RMA THE H. H. EBY MFG. CO., Philadelphia MEMBER RMA

.·. Makers of Eby Binding Posts and Sockets .·.

Bradleystat

PERFECT FILAMENT CONTROL



Provides complete noiseless filament control for all radio tubes without change of connections. Metal parts are nickel plated. One hole mounting. Self contained switch opens battery circuit when desired.

Allen-Bradley Co.

Electric Controlling Apparatus

276 Greenfield Avenue Milwaukee, Wis.

Bradleyometer

THE PERFECT POTENTIOMETER

Uses graphite disc resistors which are noiseless and not affected by atmospheric conditions. Metal parts are nickel plated. One hole mounting. Finish and knob match Bradleystat. Made in 200 and 400 ohm ratings.

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Used in the Kenneth Harkness-27 6-Tube Hook-up

See that screw

A SCREW DRIVER ADJUSTS AN X-L IN CROWDED PLACES

X-L VARIO DENSER

Used in POPULAR RADIO

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Model "N" A slight turn obtains correct tube oscillation on all tuned radio frequency circuits. Neutrodyne, Roberts two tube Browning-Drake, McMurdo Silver's Knockout, etc., capacity range ⅛ to 20-micro-micro farads. Price $1.00.

Model "G" with grid clips obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in heterodyne and positive grid bias in all sets. Capacity range:

Model G-1—.00002 to .0001 MFD
Model G-5—.0001 to .0005 MFD
Model G-10—.0003 to .001 MFD
Price $1.50

X-L PUSH POST

Push it down with your thumb, insert wire, remove pressure and wire is firmly held. Releases instantly. Price 15c.

Push Post Panel permanently marked in white on black insulating panel. In box including soldering lugs, raising bushings and screws for mounting, etc. **Price, $1.50**

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BECAUSE the Sangamo condenser is solidly molded in bakelite, mechanical movement of dielectric or plates is impossible. This is one important factor in the permanent accuracy of the Sangamo.

No one has greater need for condenser accuracy than a great broadcasting station like WGN. Read Mr. Leverett's comment:

"Last June I used Sangamo Mica Condensers in a multiple band pass filter. This has been in use for some time, and has given the best of results, showing no shifting of the frequency band. This permanency I believe is due entirely to the consistency of these condensers, there being no apparent change in capacity nor leakage across them. I cheerfully recommend them wherever a constant capacity is required.

(Signed) Geo. H. Leverett,
Asst. Engineer"
Station WGN Chicago

Sangamo Condenser Blocks

American-made condensers, wound under uniform tension to eliminate air or ozone bubbles that cause breakdowns.

Handy sizes:
12 mfd. tapped 8, 2, 2 mfd.
14 mfd. tapped 8, 2, 2, 1, 1 mfd.
14 mfd. tapped 4 (high voltage), 4, 2, 1, 1, 1, 1 mfd.

Also separate condensers; special capacity blocks to order.

Sangamo Electric Company
6332-11 *Springfield, Illinois*

RADIO DIVISION, 50 Church Street, New York

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WITH THE EXPERIMENTERS

CONDUCTED BY RICHARD LORD

What Is the Ideal Type of Variable Condenser?

To obtain a uniform distribution of station tuning over the entire dial range of variable condensers has been the ambition of alert engineers since the inception of the "straight-line" mania. It was thought at first that the "Philosopher's Stone" of tuning was represented by the straight-line-capacity condenser but experience finally dampened the ardor of its advocates. The straight-line-capacity condenser was indicted on one count only; it caused "traffic jams" on the lower wavelengths although it operated ideally on the higher wavelengths.

After straight-line-capacity, came the straight-line-wavelength idea, and here again the engineering wiseacres believed that they had completely and finally solved the problem of straight-line condensers. Again actual experience upset their calculations for the straight-line-wavelength condenser had what might be called a "peak of perfection" in the neighborhood of the medium wavelengths. That is, in the neighborhood of 50 degrees on a 100-degree dial the separation of stations was perfect and ideal conditions were effected in this small range. However, on both sides of this "peak of perfection" considerable bunching occurred and uniform distribution disappeared.

It was again believed, at first, that the straight-line-frequency condenser was the happy medium, designed, as it was, to obviate the undesirable features of its defeated predecessors. Once more experience proved that engineers were attempting to rob Peter to pay Paul and that the straight-line-frequency condenser, although it operated famously on the medium and lower ranges, fell down at the higher part of the dial.

If the straight-line-capacity, straight-line-wavelength and straight-line-frequency condensers failed to bring the results anticipated, what could be done? There was nothing else to "straight line," but it was obvious that it was possible to bring about a combination of these three effects and to produce a condenser with plates so curved that the device would effect a respectable separation of the miscellaneous wavelengths

STATIONS			DIFFERENCES BETWEEN STATIONS		SEPARATION IN DIAL DEGREES BETWEEN STATIONS USING VARIOUS TYPE CONDENSERS			
CALL LETTERS	WAVE LENGTH METERS	FREQUENCY KILOCYCLES	IN METERS	IN KILOCYCLES	STRAIGHT-LINE CAPACITY S.L.C	STRAIGHT-LINE WAVELENGTH S.L.W	STRAIGHT-LINE FREQUENCY S.L.F	STRAIGHT-LINE TUNING S.L.T
WNYC	526	570						
			34	40	11	5½	6	9½
WEAF	492	610						
			37	50	11½	6½	5	9½
WJZ	455	660						
			50	80	10½	6½	8	10½
WOR	405	740						
			45	93	8½	11	8	12
WHN	360	833						
			44	117	11	12	10	11½
WGBS	316	950						
			43	150	7	10	12	11
WFBH	273	1100						
			21	90	4	6	7½	7½
WGCP	252	1190						
			12	60	2	3½	4	3½
WHAP	240	1250						
			7	40	1½	2½	3½	3½
WNJ	233	1290						
			15	85	1½	2	4	3½
WIBI	218	1375						

A SIGNIFICANT COMPARISON OF CONDENSER TUNING CURVES

FIGURE 1: *Every one of the types of condensers that are generally used—the straight-line-capacity, the straight-line-wavelength and the straight-line-frequency—give an ideal separation of stations for a certain part of their scale; this is blocked off in red on the chart shown above. But the straight-line-tuning condenser, which embodies the best parts of each of the other types, has ideal tuning characteristics over the entire scale of the condenser.*

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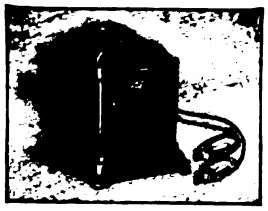
Things *you* should know about Battery Chargers

General Electric presents a complete line of Tungar Battery Chargers having sufficient range to meet the charging requirements of all radio storage batteries—large or small. Tungar is easy to use. It assures fully charged batteries over a long period of years.

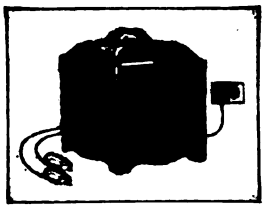
Economical and satisfactory operation of your set depends upon the correct selection of Charger as well as battery. Any good dealer will be glad to recommend the proper Tungar. But these few simple facts may be all the guide you need.

The Two-ampere Tungar



This size Tungar charges all radio "A" and "B" storage batteries and auto batteries. It is particularly suited to sets having power tubes or using considerable current. It can be permanently connected to the battery and an overnight charge once or twice a week should be sufficient.

The Five-ampere Tungar

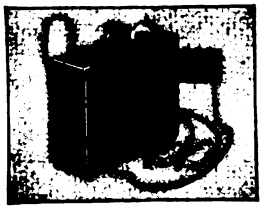


The Five-ampere Tungar also charges all radio and auto batteries. But it has a high charging rate, charges faster and is best for very large batteries.

GE Tungar
REG. U.S. PAT. OFF.
BATTERY CHARGER

Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

The Tungar Trickle Charger



This youngest and already popular member of the family should be used with low capacity 4 or 6-volt radio "A" storage batteries. It is usually permanently connected and charges continuously at a low rate.

Merchandise Department
General Electric Company
Bridgeport, Connecticut.

GENERAL ELECTRIC

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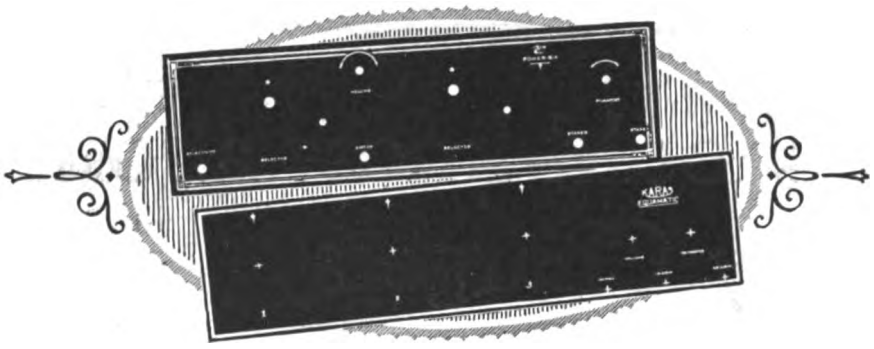

POWER S.X, KARAS, H. F. L.

ADDED to the list of handsomely Veri Chromed Formica kit panels are now the Bremer Tully Power Six, Karas Equamatic front and sub panels, H. F. L. Nine in Line Superheterodyne with sub panel, Victoreen Universal single dial control. There are also Infradyne 7 x 28, and 7 x 30, Aerodyne, St. James 8 Tube, Bremer Tully Counterphase, Browning Drake National, Madison Moore Superheterodyne, Camfield Duoformer. They are sold by leading jobbers and dealers.

Special panels cut to size and Formica tubing are also available for Amateurs

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Elkay Equalizors replace variable rheostats, delivering correct voltage to any type of tube *automatically*. To use any combination of tubes in same set, merely insert correct value of Equalizor; there is one for every tube made. Before building your set, write for folder to The

Langbein-Kaufman Radio Co. (Dept. P)
62 Franklin St.
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50c Each
75c Mounted

CeCo
A Type for Every Radio Need

Write for data sheet of the Complete CeCo Line

C. E. MFG. CO., Inc.
Providence, R. I.
Largest Plant in the World Making Radio Tubes Exclusively

over the complete range of the dial.

It is encouraging to note that the experimental laboratories of our condenser manufacturers have recently been dedicated to the perfection of condensers of this type. "Straight-line-tuning," is the term used in connection with this device and while the positive elimination of all condenser ills and problems has not been entirely accomplished, expert opinion expresses itself freely in favor of the straight-line-tuning condenser.

The radio experimenter does not need to be told that the embodiment of all of the features of the capacity, frequency and wavelength type of straight-line condensers into a straight-line-tuning device would naturally bring about greater selectivity. It is natural that the crowding of any group of stations into low, middle or upper ranges does not tend to facilitate tuning and trouble usually appears on the dial at the point where the condenser falls down. The straight-line-tuning condenser brings about this separation in an ideal way.

Actual tests using various types of condensers with appropriate size coils to cover the broadcast wavelength range are enlightening. In the table in Figure 1, the column headed "Wavelengths," lists the wavelengths of eleven stations in a typically radio-congested locality. The next two columns show differences in wavelength and frequency between these successive stations. How far apart or how close together will one log these stations on the dial is well shown in the next main column, labelled, "Separation in Dial Degrees."

Using an SLC (straight-line-capacity) condenser the stations below 275 meters are so badly bunched together that one has to split hairs in tuning them. Above 400 meters, however, this condenser affords pleasurable tuning.

Now considering the SLW (straight-line-wavelength) condenser column, we notice that low-wave stations are a bit further separated than with the SLC, but the tuning of the high-wave stations has changed to a crowded and bunched grouping. However, stations in the central broadcast range, *i. e.*, between 300 to 400 meters approximately, are now ideally separated. The third sub-column in this group shows how the famous SLF (straight-line-frequency) condenser places these same stations on the dial. The low-wave stations are now placed quite a ways apart on the dial in an ideal manner, but the central band of stations are not quite as well separated as with the SLW type of condenser and the stations from 400 meters upward are now closely bunched together.

To sum up, the SLC condenser was excellent on the upper range, shown in red, the SLW was best on the middle range, shown in red, and the SLF was most satisfactory on the low range of stations, also shown in red.

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Our 24 Hour Service means Delivery at once—so order TODAY

We also distribute the following:

INFRADYNE QUADRAFORMER
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We are the largest parts distributors in the East, carrying a most complete stock.

Write for our 1927 Catalog

LEWIS RADIO JOBBERS
The wholesaler for KH-27
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Sheet Copper for Shielding

Shielding

Prevents **aerial radiation and feedback.**

Insulates **against interference from adjoining circuits.**

Improves **efficiency, selectivity and tone quality.**

USE SHEET COPPER because it combines low resistance with easy working qualities.

COPPER & BRASS
RESEARCH ASSOCIATION
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From a photograph made for POPULAR RADIO

MAKING ACCURATE ELECTRICAL MEASUREMENTS

FIGURE 2: *A full understanding of electromotive force and current is necessary before the experimenter can hope to do any worthwhile experimental work.*

It naturally follows that a condenser combining the separate good tuning qualities of the above three types would represent an ideal tuning device. The practical embodiment of these three qualifications is the SLT (straight-line-tuning) condenser. Just how it compares with the three other types is evident from the figures shown in the column. Notice that the SLT condenser listed in the last column covers the entire range with comfortable separation between stations.

—RAYMOND F. YATES

What Electro-Motive Force and Current Are

To understand the workings of an electrical circuit it is necessary to obtain a clear idea of what is meant by current and what is meant by pressure or voltage. One cannot proceed very far in this direction without coming face to face with another factor called resistance. Electric current is expressed in amperes, electric pressure in volts and resistance in ohms. Taken separately, neither amperes, volts nor ohms can be defined or understood; but the law applying to one (called Ohm's law) deals with all three.

The first thing to remember is that volts and amperes have nothing to do with each other except as governed by ohms. You might have a pressure of a million volts and not have a single ampere flowing in a circuit if the resistance were great enough; on the other hand you might have a thousand amperes and a pressure of only a single volt, provided the resistance was small enough, your battery large enough and that you were able to maintain the one volt pressure.

Current is the quantity of electricity flowing per unit of time. It will help our understanding if we imagine electric current flowing in a wire to be the

Save $50 to $100!

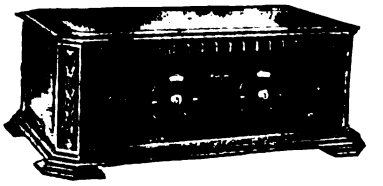
IMAGINE a radio without oscillation, without variation of volume on different wave lengths! Imagine a 5-tube receiver with the power of most expensive 8-tube sets! Imagine knife-like selectivity even in crowded areas! And tone quality as clear and pure as the natural unbroadcast signal!

That describes the 1927 Hi-Q Receiver designed by ten of America's leading Radio Engineers!

You can build this wonderful receiver yourself at home and save at least $50 over a factory-made set of anything like the same efficiency. Get the "How to Build" book and approved parts from your dealer to-day and construct the receiver designed by Radio's Master Minds.

Send for the "How to Build It" Book—

The simplest and most complete instruction book ever printed. Covers every detail. 25c.



Hammarlund ROBERTS Hi-Q

*High ratio of reactance to resistance. High ratio—Great selectivity—Loud Signals.

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$10 Wheelan Super-Cone

NOW—a full size 17" free edge *quality* cone-speaker—for only $10.00—and sold on an iron-clad guarantee of perfect satisfaction or your money back after a 5-day trial.

Guaranteed to be as excellent in tone, volume and appearance as many speakers selling at $25 or $35. Insist on seeing guarantee tag which is attached to each Wheelan Super Cone.

Hear it in your own home, on your own set. Then if you are not convinced that it is the biggest value in cone loud speakers today, your dealer will cheerfully take it back and refund your money.

See the Wheelan Super-Cone today at your dealer's. If he cannot supply you, send us his name and address and we will see that your order is filled.

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DESIGNED to OUTLAST
World Storage "A" Battery

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NEW LOW PRICES

Famous the world over for reliable, enduring performance. Solid Rubber Case lasting protection against acid or leakage.

Approved and Listed as Standard by Leading Authorities

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Send No Money

Just state number wanted and we will ship same day order is received, by express C.O.D. Pay expressman after examining batteries. 5% discount for cash with order. Remember, you save 59% on World Batteries—so send your order today.

Solid Rubber Case Radio Batteries
6-Volt, 100-Amperes $10.00
6-Volt, 120-Amperes $12.00
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Solid Rubber Case Auto Batteries
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Set your radio dials at 266.3 meters for the World Storage Battery Station WSBC. Variety—new talent—always interesting. Jerry Sullivan, Dir. and Announcer. "Chi-CAW-go"

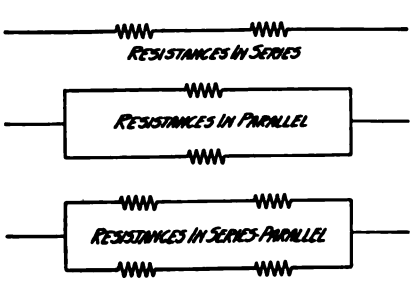
WORLD BATTERY COMPANY
Dept. 3
1219 S. Wabash Ave. Chicago, Ill.

same as water flowing in a pipe; for direct currents, this will not be far from the truth. However, we must not carry the analogy too far, for water does not ordinarily flow around a circuit and back to its starting point as electricity does.

A circuit is the path that the electric current takes from the battery or dynamo where it originates, through whatever instruments or machines it is desired to operate, and back to its place of origin. If the instruments or machines are connected in a single path by a wire and the current passes through one after another, they are said to be connected in "series," but if the current divides and part of it passes through one device and another part through another device, they are said to be connected in "multiple." In a series circuit the same current passes through all of the units in the circuit but in a multiple circuit the current splits and the amount that passes through each branch is governed by the resistance met with in that branch.

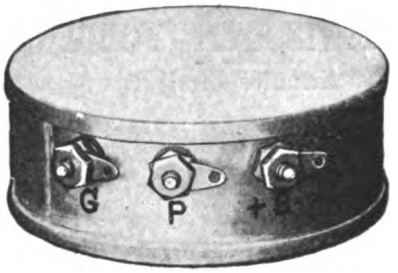
Resistance is the sum total of the obstacles encountered by the current in its passage through the circuit. If the wire or other conductor which makes the circuit be short in length and reasonably large in diameter, a current may be forced through by a low voltage. But, if we use a smaller wire or a greater length the same voltage will not be able to force as much current through.

If a man, measuring eighteen inches across the shoulders, were to attempt to crawl through a hundred yards of pipe sixteen inches in diameter he would meet with considerable "resistance" and would not be able to travel as fast as if the pipe were larger. If we say this man's strength is represented by a certain number of "volts" at the beginning of his journey through the pipe, we can see that he would suffer a big "drop in voltage" by the time he reached the end. On the other hand, if the pipe were larger he would be stronger when he finished, and if we say his body represents one ampere of current, it could pass a given point quicker, which would be equivalent to a greater num-



THREE WAYS TO CONNECT RESISTANCES

FIGURE 3: *These simple diagrams show, at the top, two resistances in series, in the middle, two resistances in parallel and below four resistances that are connected in series-parallel.*



Shielded Tuned Radio Transformer, No. 30

SICKLES
Diamond-Weave Coils

The new Sickles Shielded Tuned Radio Transformer prevents both outside and local interference. It is remarkably compact, sharp-tuning, sturdy.

Sickles Diamond-Weave Coils have established an enviable reputation for low distributed capacity, low dielectric losses, and large range of frequency with small variable capacity.

The ideal coil for the Na-Ald Localized Control Tuning Unit and the Na-Ald Truphonic Assembly.

There are Sickles Diamond-Weave Coils for all leading circuits.

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No.	Coil Prices	
30	Shielded Transformer	$2.00 each
24	Browning Drake	7.50 set
18A	Roberts Circuit	8.00 set
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ber of amperes in unit time. Again, if he had only to crawl through twenty feet of the smaller pipe he could also come out with less loss of strength—that is "voltage."

It is the same with any number of volts from a battery or other source of electromotive force; the longer the wire or the smaller its size the greater will be the loss of voltage and the less the current that will flow. From this, it is easy to see that, other things being the same, the greater the resistance, the less will be the current and the less the resistance the greater the current. This is covered by Ohm's Law, which relates to direct currents, and is as follows: The strength of current is directly proportional to the electro-motive force and inversely proportional to the resistance; that is,

$$\text{Voltage} = \text{Current} \times \text{Resistance}$$

$$\text{Current} = \frac{\text{Electromotive Force}}{\text{Resistance}}$$

$$\text{Resistance} = \frac{\text{Electromotive Force}}{\text{Current}}$$

A direct current is one that flows continuously in the same direction. It is the kind that flows through the filament of your electron tube.

An alternating current is one that reverses its direction periodically. Two reversals (or a current impulse in each direction) constitute a cycle, and the number of cycles per second most generally used in electric power and lighting is 60 per second, and that used most in radio telephony and telegraphy ranges from 1,500,000, when the wavelength is 200 meters down to 100,000, when the wavelength is 3,000 meters.

The application of Ohm's Law to alternating currents involves factors not met with in continuous current circuits, and is beyond the scope of this article.

—GAY PRENTICE BLESSING

Obscure Trouble-makers

HERE are trouble makers recently unearthed by a Federal radio supervisor in Oregon:

A sign on a street corner peanut roaster in an Oregon city, which caused trouble fifteen blocks away:

A small but active motor with a dirty commutator and improperly fitted brush:

Twelve defective flour bleachers equipped with electrical arcs in an Oregon flour mill:

Faulty insulators and other power line equipment on a high-voltage transmission line carrying 66,000 volts, which were found to be causing considerable interference to radio fans in western central Oregon.

In its desire to cooperate with the fans of that section the power company has appropriated money with which to purchase an auto equipped with a trouble-finding set, and has appointed a radio expert to patrol its lines.

TOBE

TRADE MARK

for the

LC-27

The NEW TOBE 400-Volt Condenser

This is a new line of TOBE High-voltage Condensers, for 400 volts continuous operating voltage. The advent of the Raytheon BH Tube has made necessary condensers for higher working voltages than those formerly employed, in cases where the B-Eliminator Transformers deliver voltages in excess of 300 volts. The TOBE 400-volt Condenser is of the *short-path* type, is cased in a substantial metal container with heavy lugs, for attachment to baseboard or sub panel and is equipped with new and unique base terminals, for shortness of wiring and safety. These terminals are not found on any other make of condenser.

In the characteristic TOBE silvered finish, No. 401, 1 Mfd., $2.00
" 402, 2 " 2.75
" 404, 4 " 4.50

TOBE Output Filter Condenser

This 4 mfd. TOBE Condenser,—maximum working voltage 250 volts,—has been specially designed to save space in the construction of power tube output filters, now so generally required between the power tube plate of a Radio set and the speaker,—for protection of speaker windings and improvement of tone quality. An output device of this kind is recommended with the UX-171 and all other high-voltage power tubes.

Price, $3.50

The TOBE Veritas HI-Current Resistor

A special and unexcelled resistor, capable of radiating 4 to 5 watts continuously without change or deterioriation. Unexcelled for use in B-Eliminators and for transmitting grid leaks. Made to be soldered directly into the circuits without the use of clips, although of standard length, so that standard mounts may be used if desired.

Prices—2,000, 2,500, 3,000, 5,000, 7,500 and 10,000 ohms.....$1.10 each
50,000 ohms..... .90 "
.1 meg..... .80 "
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GLENN H. BROWNING, Laurence M. Cockaday, Gerald M. Best and many other eminent radio designers use the Lynch Metallized Resistor in their experimental circuits and receivers. These men *know* radio; they have laboratory and testing equipment with which quickly to make accurate comparisons. There could be no better proof of the true merit of the Lynch Metallized Resistor than the endorsement of these experts.

Comprising a concentrated metallized deposit one-thousandth of an inch thick upon a rigid core, sealed forever within a glass tube, the Lynch Metallized Resistor gives *conductive*, non-arcing resistance that remains silent, accurate!

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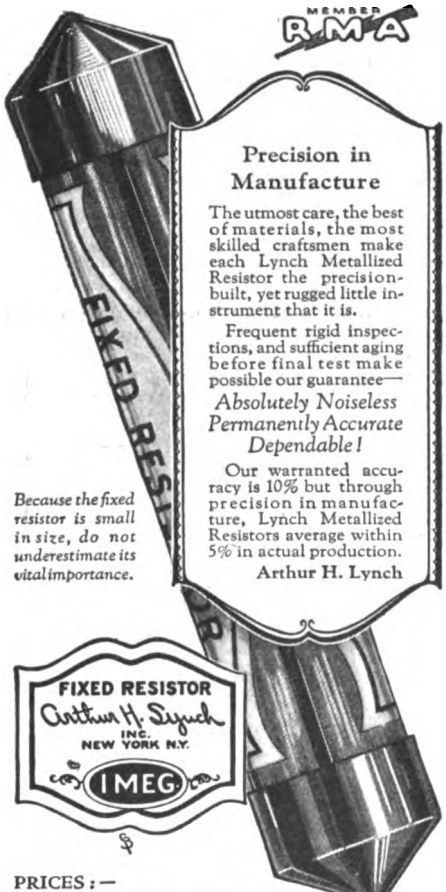

Precision in Manufacture

The utmost care, the best of materials, the most skilled craftsmen make each Lynch Metallized Resistor the precision-built, yet rugged little instrument that it is.

Frequent rigid inspections, and sufficient aging before final test make possible our guarantee—

Absolutely Noiseless
Permanently Accurate
Dependable!

Our warranted accuracy is 10% but through precision in manufacture, Lynch Metallized Resistors average within 5% in actual production.

Arthur H. Lynch

Because the fixed resistor is small in size, do not underestimate its vital importance.

PRICES:—

.25 to 10 Megohms	.50		
above .01 to .24 "	.75	Single Mounting	.35
.001 to .01 "	$1.00	Double "	.50

Lynch Metallized Resistors cost no more than the ordinary kind. If your dealer cannot supply you it will be well worth your while to wait for the mail—we ship post-paid, at once.

LYNCH METALLIZED
FIXED RESISTORS

How to Build the New KH-27 Receiver

(*Continued from page 20*)

audio frequencies can be obtained. In this respect resistance and impedance amplifiers are practically alike. Much higher amplification is obtainable, however, with impedance coupling using standard tubes and ordinary plate voltages.

The use of choke coils as grid-leaks *definitely and effectively remedies the inherent weakness of the earlier types of impedance amplifiers*. Each choke coil grid-leak offers an impedance of over one million ohms to the audio-frequency signal but the DC resistance of the choke is less than 2000 ohms and excess grid charges are immediately conveyed to the filament.

All possibility of distortion or blocking on this account is therefore eliminated. There is practically no limit to the volume that can be accommodated as far as this aspect of the system is concerned and full advantage can be taken of the amplifying characteristics of the tubes in the amplifier. The double-impedance amplifier is so perfect in this respect that almost any number of stages can be used. As many as seven stages have been employed without tube blocking taking place. It is unnecessary, however, to use more than three stages in the average receiving set.

The double-impedance, audio-frequency amplifier possesses many other unusual and important characteristics which are, however, beyond the scope of this article.

Another feature of the set is the output tone filter which passes the direct current to the plate of the last tube, through a choke coil, and permits only audio-frequency currents to pass through the blocking condenser and the loudspeaker windings.

How to Construct the Set

The parts required to build this set are listed at the head of this article.

When all the instruments and materials for building the set have been procured, the front and sub-panels, U and V, shown in Figure 2 should be prepared.

First, cut the front panel, U, to the correct size, 7 by 26 inches, and the sub-panel, V, to 7 by 25 inches. Then square up the edges smoothly with a file. The centers for boring the holes by which the instruments are mounted should then be laid out on a panel as shown in Figures 7 and 8. A convenient method is to lay out all center holes on a piece of paper the same size as the panel; then the piece of paper may be fastened on the panel and the centers marked directly on the panel by punching through the paper with a sharp, pointed instrument.

If all the holes to be drilled are first

Potter Condensers

Build the best—

Socket Power Devices
—A and B Supply Devices
Power Amplifiers
Impedance Amplifiers

And are best—

For Filter Uses
Rectifiers
By Pass
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American made of best of materials to full capacity. All sizes and types.

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Potter
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Condensers

Build It Yourself

IN one evening and for 1/5 the retail cost you can build a 3 foot cone speaker equal in every way to the finest factory-built cone speaker. Marvelous tone quality; reproduces perfectly every instrument in a complete symphony orchestra—the very lowest tones are clear, distinct and musical; the high notes are mellow and round. You'll really enjoy reception with this 3 foot cone equipped with

3 FOOT CONE SPEAKER

Parts Complete $14.15
Including Unit

Penn Cone Speaker UNIT

designed especially for 3 foot cone; operates wonderfully with power tubes. Price $9.50.

Complete set of parts—2 sheets genuine Alhambra Fonotex pair Back Rings, Unit Mountings, can Special Ambroid Cement and PENN Cone Speaker Unit—only $14.15.

Ask your dealer. If he will not get it for you, we will ship you on receipt of price; or balance C.O.D. if you send deposit of $5.

Pamphlet, "*How to Build a Giant 3 Foot Cone Speaker for only* $14.15" sent for 10c., coin or stamps.

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104 Fifth Avenue Suite 2009 New York City
Exclusive Selling Agents for G. R. Penn Mfg. Co., New York

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started with a small drill, one-sixteenth of an inch in diameter or less, they can be more nearly centered.

The list of parts includes only the exact parts used in the set built by the author and shown in the illustrations. This set uses a completely drilled sub-panel in which the manufacturer has already rivetted six tube sockets, T1 to T6, inclusive. Those who wish to drill their own sub-panels will require six regular tube sockets of the sub-panel mounting type in addition to the parts listed. These six sockets should be mounted with nuts and bolts in the holes indicated in Figure 7.

After the panels are drilled, the builder may give them a dull finish by rubbing the face of the panels lengthwise with fine sandpaper until smooth. This process may be repeated, applying light machine oil during the second rubbing. Then rub the panel dry with a piece of cheesecloth.

A permanent dull finish will be the result. Or the panel may be left with its original shiny-black finish, if care has been exercised not to scratch it during the drilling.

If ready-made drilled and engraved front and sub-panels are bought, the work described above will be unnecessary as the drilling and finishing have already been done by the manufacturer of the panels. The panels, in this case, are beautifully made of black bakelite and, as mentioned above, the six tube sockets are securely rivetted to the sub-panel.

After the panels U and V have been prepared, or ready-made panels purchased, the builder is ready to mount the instruments on them.

First attach the sub-panel, V, to the front panel, U, by means of the two bakelite mounting brackets, W1 and W2. Then turn the set up on end so that you can reach both sides of the sub-panel, V. Figures 2, 3, 4 and 5 clearly show the positions occupied by the various parts.

On the lower side of the sub-panel, V, mount the four automatic filament controls, O1, O2, O3 and O4, the grid-leak mounting for the grid-leak, L, the fixed condenser, G, the two by-pass condensers, H and I, and the output filter choke coil, E. Note that the automatic filament control, O4, is mounted next the last tube, T6, at the extreme left of Figure 4 and the grid-leak mounting, for the grid-leak, L, is near the detector tube, T3, at the extreme right. The fixed condenser, G, is bolted to the sub-panel, V, near the detector tube, T3, on the right.

When screwing condenser G in position, attach soldering lugs on *top* of the sub-panel, V, and hold the condenser, G, off the lower side of the sub-panel with washers to insure firm contact to the terminals. The two fixed condensers, H and I, are not mounted on the

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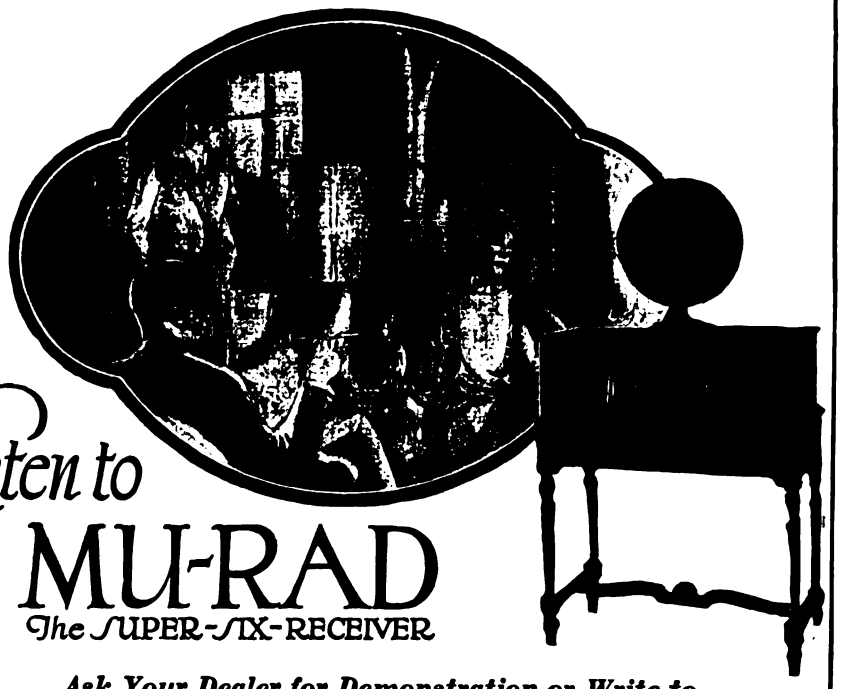

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sub-panel, V, but are held in position by the bus-bar wiring. Note that the figures show old type Dubilier by-pass condensers at J and K. The new type condensers may, of course, be used.

On the top of the sub-panel mount the coils, A1, A2 and A3, the two neutralizing condensers, C1 and C2, the fixed resistance, M, the eleven binding posts, Y1 and Y11, inclusive and the three double-impedance couplers, D1, D2 and D3. Looking down on the sub-panel, V, as shown in Figure 5, mount A1 on the right, A2 in the center and A3 on the left. Be sure to mount these coils in the proper holes; all three should be inclined at the same angle. Brass bolts must be used as the bolts are utilized to form electrical connections. When mounting these coils attach soldering lugs so that wires may be soldered to the bolts on both top and bottom of the sub-panel, V. *Before mounting coil A3, screw one end of the grid condenser, F, in place; then bolt the grid end of coil A3 through the sub-panel, V, to the opposite terminal of the grid condenser, F. The mounting bolt is used to attach both parts to the sub-panel, V, and forms a direct electrical connection from A3, to the grid condenser, F.*

When mounting the double-impedance couplers, D1, D2 and D3, to the sub-panel, V, make sure that the primary terminals (P and B) of each coupler point towards the left-hand side of the set when looking down on the sub-panel, V, as in Figure 5.

Now remove the shafts from two of the variable condensers, B2 and B3. Mount condenser B2 on the right-hand side of the front panel, U (looking from the front), and pass a screw through the aluminum casting of the condenser so that it passes through the hole drilled for that purpose in the sub-panel, V, and bolt condenser B2 securely to the sub-panel, V, directly behind the first condenser, B2. Then pass the nine-inch extension shaft through both condensers, B2 and B3, leaving enough of the shaft projecting through the front panel U, to mount the dial, Z2, thereon. Turn both rotors of the condensers, B2 and B3, to the same positions and tighten the shaft in place.

Note that the extension should pass through the two condensers easily. If you find it necessary to force the shaft or raise the sub-panel, V, to permit the shaft to pass through, loosen the nut holding the front condenser, B2, to the sub-panel, V, until the two condensers, B2 and B3, line up accurately.

Mount the remaining variable condenser, B1, on the left-hand side of the front panel, U (looking from the front). Also mount the antenna switch, R, and the phone jack, P, on the left, the battery switch, S, and the pilot light bracket, Q, on the right and the rheostat, N, in the center. Finally mount the two vernier dials, Z1 and Z2, in

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place. Full instructions are given by the manufacturers that explain the easiest way to mount these dials.

This completes the assembly and the set is now ready to be wired.

How to Wire the Set

The design of this set is such that the wiring of the grid circuit of each of the six tubes, and other wiring that carries high potential currents, are made extremely short and are isolated from other parts of the circuit. In fact, this idea has been employed throughout and the leads are so arranged that the shortest connections may be used. The set should therefore be wired with bus-bar.

Either a tinned-copper bus bar or an insulated bus wire such as "Celatsite" may be used for the connections. All connections should first be shaped so that they will fit. They should then be soldered in place.

Refer to the wiring diagram in Figure 6 and more specifically to the picture wiring diagrams in Figures 4 and 5 for the exact way in which to run the wires.

As the wiring instructions given in these diagrams are so explicit, it is not necessary to explain them in detail.

Start by wiring the lower side of the sub-panel, V. Note that the 67-volt binding post, Y5, is connected to the mounting bolts of coils A2 and A3. On the top of the sub-panel, V, these mounting bolts are connected to the primaries of coils A2 and A3. Note also that the radio-frequency, by-pass condenser, K, must be connected directly to the ground binding post, Y8, as shown in the picture wiring diagram.

When the wiring of the lower side of the sub-panel, V, pictured in Figure 4 is finished, turn the set over and complete the wiring as shown in Figure 5. No verbal comment is necessary. The diagrams clearly show all the wiring.

The set is now ready to be installed.

How to Install the Set

Insert the finished set in the cabinet which has been provided for it. Then with a seven-conductor cable, connect the set to a standard 6-volt storage "A" battery and four 45-volt standard, heavy-duty "B" batteries as shown in Figure 10. Also connect a "C" battery of from 16 to 40 volts, as shown, if a UX-171 type tube is used in the last stage. The best "C" battery voltage can be determined by test. If a UX-112 type or UX-201-a type tube is used in the last stage use no "C" battery at all. In this case short-circuit the "C" battery binding posts with a piece of wire. This is unusual but the double-impedance amplifier operates better without a "C" battery except when a UX-171 type or UX-210 type tube is used in the last stage. Furthermore, the full 180-volt "B" battery potential should be used although good results can be obtained with only 135 volts.

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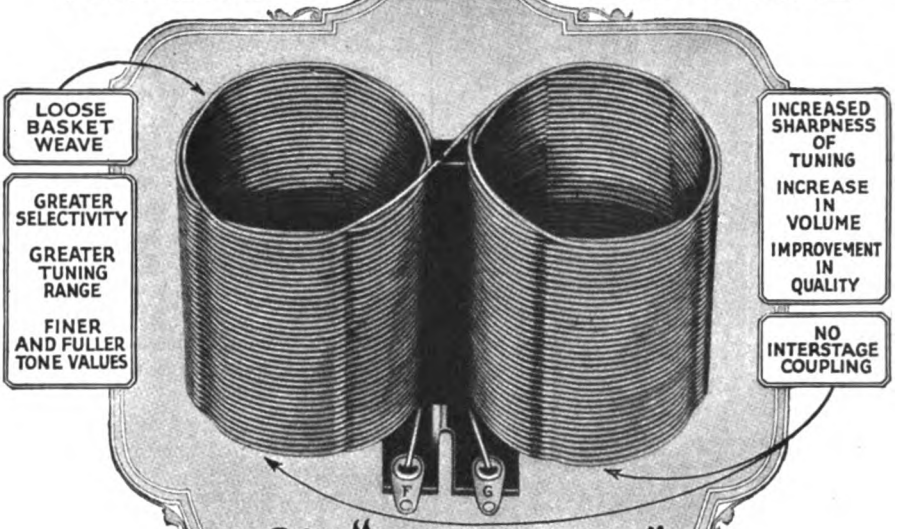

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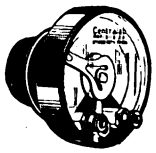

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Do not use less than 135 volts.

Connect the antenna and ground wires to the set, as shown in Figure 10. Make these two leads as short as possible and do not twist them together. Keep the antenna lead clear of both the ground and the battery leads.

Insert the tubes in the sockets. The tubes in sockets T1, T2, T4 and T5 should be of the UX-201-a type. The tube in socket T3 may be a UX-201-a or a UX-200-a type tube, preferably the latter if distance reception is desired. If a UX-200-a type tube is used insert the grid-leak in the clips of the grid condenser itself to provide a negative bias. If a UX-201-a type tube is used as detector, insert the grid-leak in the separate grid-leak mounting, to provide a positive bias.

If a UX-171 type tube is used in socket T6, it is much more economical to operate the set with a "B" power-pack instead of the four "B" batteries shown. Power-packs of this type may be purchased or constructed.

When an eliminator is used to supply the plate current a disagreeable noise known as "motor-boating" is sometimes heard. This can be removed by inserting three 10,000-ohm Lavite resistances between the power-pack and binding-post Y3, binding post Y4, and binding post Y5, respectively. If the power-pack is not supplied with a 67-volt tap, connect to the 90-volt tap and, if necessary, reduce the voltage supplied to the plates of the amplifying tubes by increasing the value of the Lavite resistance in series with this lead until the set can be easily neutralized.

How to Neutralize the Set

When the set has been installed, as described above, it must be neutralized before it is ready for continuous operation.

Turn on the battery switch, S, turn the rheostat volume control, N, to its maximum position and plug in your loudspeaker. Turn the antenna switch, R, so that only eight turns are included in series with the antenna.

Then take the second amplifier tube out of its socket, T2, wrap a little paper round one of the filament prongs and replace the tube in its socket so that it does not light. Then tune in some local station and adjust the capacity of the second neutralizing condenser C2 with an insulated screw driver. It will be noticed that at a certain value of capacity the signal is practically inaudible. If the capacity is either increased or decreased the signal again becomes audible. Set the neutralizing condenser C2 at the point at which the signal is inaudible. Then remove the paper from the filament prong and replace the tube in its socket.

Perform the same operation described above with the first tube in socket T1, adjusting the capacity of the first neu-

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tralizing condenser C1, until the signal is also inaudible or at minimum audibility. Remove the paper from the filament prong and replace the first tube in its socket.

Now, revolve the two tuning dials, Z1 and Z2, in unison from 100 down to zero. The set should not oscillate. If it does, adjust the neutralizing condensers until the oscillations disappear.

General Operating Instructions

When the set has been accurately neutralized the set is ready for operation.

Stations are tuned in by turning the two vernier dials, Z1 and Z2. They should read approximately alike for any given station. Volume is controlled by the center knob turning the filament rheostat, N. This rheostat may be turned on full without harming the tubes. The resistance, M, is at all times in series with the filaments of the radio-frequency tubes.

The volume of the set should be carefully adjusted to give the best quality.

The antenna switch, R, should ordinarily be kept in the position in which only eight turns of the antenna coil, A1, are in series with the antenna. In this position low-wave stations are received best and the set is more selective for the reception of local stations. The switch, R, should only be turned to the opposite position when you wish to receive distant stations.

To maintain good operation watch your tubes and batteries. In common with every other set, good quality cannot be obtained with run-down batteries or inferior tubes.

If at all possible, use a large cone speaker with this set. If you use an inferior type of horn speaker or cone speaker you cannot possibly expect to obtain good tone quality. It is absolutely necessary to use a loudspeaker which will do justice to the set and which will accurately reproduce the undistorted electric energy supplied to it by the receiver.

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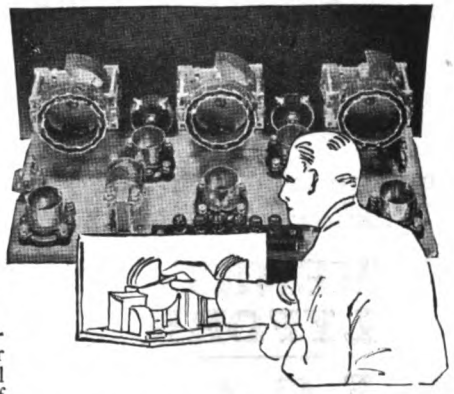

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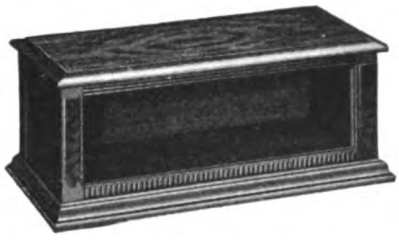

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When the iron gets hot it has to be placed on a piece of metal, glass or porcelain to keep it from burning the table top while it lies idle between the actual soldering operations.

I had an old desk extension for a telephone, as shown in Figure 1, and conceived the idea of using it for a solderi g iron support.

Now, I never burn the table or anything lying on it, as I simply put the iron in the round part of the support, that ordinarily holds the telephone, and push it back out of the way.

I find this a very handy idea and believe that my fellow set-builders would do well to try it.

—ROBERT W. TAIT, *New York City*

How I Improved Selectivity By the Use of Two Receivers

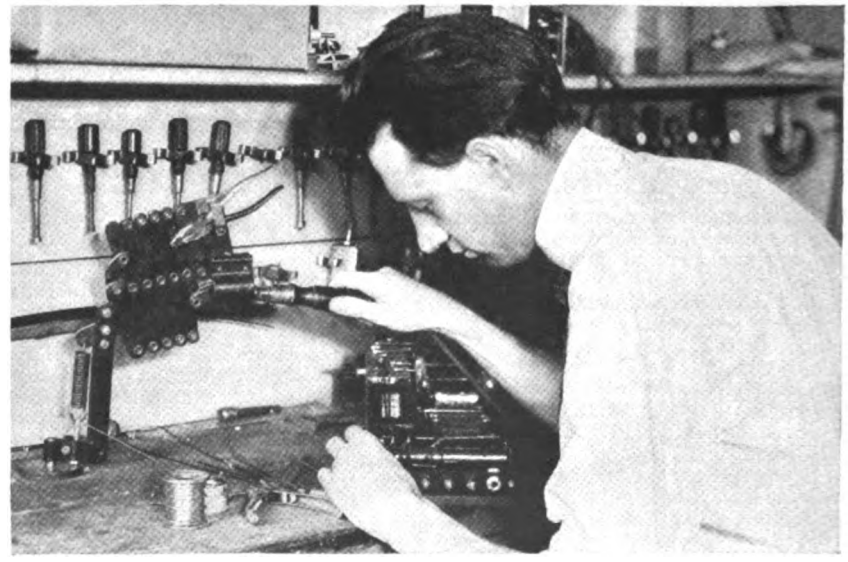
THREE months ago I built my first set, a simple crystal set with one dial control, as described in POPULAR RADIO.

A month later I built a larger five-tube receiver according to instructions in your magazine.

I live only a half a block away from station WFBH. When I had completed the set I found that I could not separate WFBH from stations on nearby wavelengths although I could get WJZ and WEAF without any interference.

One night when my smaller brother had been listening to the crystal set, I happened to turn on the large five-tube receiver, about three feet away from the other, with no aerial or ground. Immediately I began to pick up signals and I found that I could tune in all of the local stations without interference from WFBH.

Later I found that by turning the crystal set around so that it assumed



HOW TO MAKE A SUPPORT FOR YOUR IRON

FIGURE 1: *The soldering iron fits into the fixture on the extension that is ordinarily used for holding the telephone. The extension may be pulled out or turned in any position so that the iron will always be handy for soldering.*

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Cooper A Eliminator

The "A" Battery is gone - - - *- - - forever!*

NOW you can enjoy radio without having to put up with the inconveniences caused by the storage "A" battery, for the "A" battery has been totally eliminated as a radio necessity.

The Cooper "A" Eliminator actually eliminates the "A" battery with all its messy watering and charging. Just plug the Cooper "A" Eliminator into the light socket and turn on the set . . . a simple throw of a switch and the current is on . . . tumble back the switch and the current is off . . . supplies up to 2½ amperes of current, enough to operate any make of receiver using up to ten six-volt tubes.

The Cooper "A" Eliminator is not a power unit. It employs no trickle charger. It needs no attention of any kind . . no batteries to water . . no acids or liquids to replace . . operates purely on a rectification and filtration principle . . . creates noiseless, distortionless filament current direct from the house lighting system.

This Free Booklet Tells the Story

We have prepared a very complete folder describing the Cooper "A" Eliminator and the principle upon which it is built. May we send it to you?

Good radio dealers in most cities have the Cooper "A" Eliminator on display, $87.50 (tubes extra); slightly higher West of the Rockies.

DEALERS—JOBBERS

The Cooper "A" Eliminator is entirely different from the many "A" power devices on the market. It offers tremendous sales possibilities. Limited distribution and full protection to trade outlets insure legitimate profit. Write for full particulars of our exclusive proposition.

THE COOPER CORPORATION

Radio Division—Dep't P

CINCINNATI, OHIO

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STABILIZING DETECTOR UNIT

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IN U. S. A.
WITHOUT
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It is an absolute revelation and one of its great features is the Carborundum Stabilizing Detector Unit employed as a second detector.

With this marvelous set you will get crystal clear tones at super-het volume to spare—greater distance—increased sensitivity

And one of the great reasons for its remarkable success is the

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CARBORUNDUM GRID LEAKS
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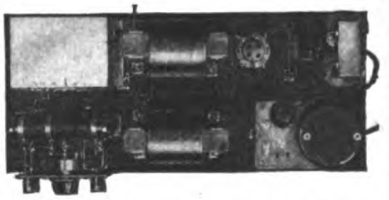
The "SELF-ADJUSTING" Rheostat

For the
K.H.-27, also!



The Intermediate Power Pack

DEVELOPED by Laurence M. Cockaday of POPULAR RADIO. Designed to operate the LC-27, K.H.-27 or *any other* power tube set. Gives a constant, uniform current of 180 volts at 60 mils. without distortion or hum. Voltage taps as on standard B batteries. No liquids or moving parts. After it is connected you can forget it.

You can build the Intermediate Power Pack in two hours, ready for operation, it is so simple and easy to construct.

A unique feature is a means provided for dispensing with the antenna on a Neutrodyne or any type of Tuned R.F. Receiver.

Complete list of parts as used in the laboratory model, including a 40 volt C bias for the UX-171 power tube, and Yaxley Automatic Relay $47.50.

If your dealer cannot supply you, send check or money order direct.

Filtrex B Power Supply

The Intermediate Power Pack is also built complete and encased in a beautiful metal case, finished in Duco midnight blue. Guaranteed against mechanical defects. Approved by POPULAR RADIO LABORATORY. Dealers write for information.

CONNER CROUSE CORP.
52 Vanderbilt Avenue, New York

a certain position in relation to the big set, that I could get the stronger signals from the bigger set. In this way I cut out all my interference and am able to get out of town stations even while WFBH is going full blast.

—H. B. KRONTIN, *Newark, N. J.*

* *

How I Log Stations

I KEEP a small index file with a separate card for each station that I tune in on my set. I file the stations away alphabetically by call letters in one part of the file and alphabetically by cities in another section.

I include in this file all the data on wavelength, frequency, dial settings and strength of signals and I go over the file once every month or so with additional information on fading, quality of reception and signal strength. In this way, I am able to tell whether my set is working properly and keep a check on any new stations that may have started up as time goes by.

I also find this file a great help in logging and tuning in any out-of-town stations when I have visitors who want to hear how the set performs.

—HARRY SELTZ, *Atlanta, Ga.*

* *

A Handy Support for Drilling Panels

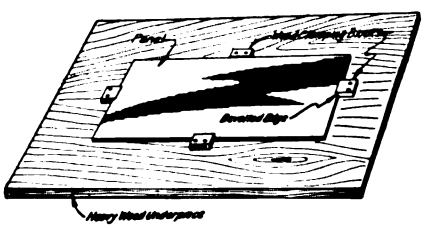
I HAVE found the following little "kink" useful in drilling large and unwieldy bakelite panels.

Cut a piece of wood, a half-inch or one-inch thick to a size about half again as big as the panel. Place the panel in the middle of this board and hold it in position by four blocks of wood, one at each edge, nailed to the wood underpiece.

Figure 2 shows a cross-section of one of these blocks of wood.

The heavy underpiece of wood serves a triple purpose; it keeps the drills from biting into and marring the table top after they have gone through the bakelite, it keeps the back of the bakelite from breaking out and the weight of it keeps the panel from sliding all over the work bench. The four blocks keep the panel held firmly down against this heavy piece of wood (as shown in Figure 2), and keep it from moving while the laying-out and drilling operations are going on.

—CHARLES F. FELSTEAD (6 CU), *Los Angeles, Cal.*



A PANEL SUPPORT

FIGURE 2: *How a panel may be fastened securely to the work-bench by means of wood clamping blocks for an accurate drilling job.*

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A Simple Circuit Tester

IN testing out receivers for faults in the coils or short circuits in the condensers, I find it is quite a help to install a series lamp testing outfit. This consists of a double length of lamp cord of about 6 feet in length with a lamp socket in series with one of the wires. In this lamp socket I place a 25-watt carbon lamp and I attach two wooden handle prick-punches to the ends of the wires.

To test out a coil I take the two wooden handles, one in each hand, and touch the bare metal ends of the punches to the two ends of the coils. If there is no open circuit the lamp will glow but if the wire is broken in the coil the lamp will not light.

In testing a condenser the metal ends of the two punches should be attached to the rotor and stator terminals respectively. If the lamp lights the condenser is shorted but if it is in good condition the lamp will not light.

Of course, the coils and condensers should be disconnected from the rest of the circuit while they are being tested.

—G. A. HOPKINS, *New York City*

* *

How I Insure Good Contact to My Vacuum Tubes

PERIODICALLY I take out all the tubes used in my set and clean the bottoms of the prongs with a small piece of very fine emery paper. This brightens up the drop of lead on the bottom of the prongs and insures a better connection to the spring contacts in the sockets.

I have been able to clear up reception and improve the whole set in a few minutes by this simple process. The tubes often get dirty contacts and add resistance to the circuits and should be cleaned in this manner every month or so.

—EDWARD RAMMEON, *Lynchburg, Va.*

* *

The Pin-jack Voltmeter

I HAVE found that I can economize on the instruments that are used in my experimental receivers by installing pin jacks on the panel, spaced properly to accommodate the standard makes of pin-jack voltmeters, so that I can use a single voltmeter and measure the "A" battery voltages on a number of sets with which I am experimenting.

It is a big job to prepare the large holes to fasten a regular voltmeter on the panel and a new voltmeter must be obtained for every set that is built. By the use of the above mentioned jacks and a pin-jack voltmeter, I can use the same instrument over and over again without rearranging the wiring of the set in the least.

—MAURICE SEIGRIST, *Los Angeles, Cal.*

As in the Harp, whose short and long strings produce high and low notes, the SAAL Ec-centric provides a short radius for high notes, a long radius for bass tones.

Ec-centric

—the new scientific SAAL EC-CENTRIC CONE
whose balanced tone color is the sensation in radio today

Your receiving set may be *getting* all of the best that's on the air—but are *you* getting it? You cannot know the capabilities of your radio set, in volume, clarity, beauty of tone till you give it the advantage of the Saal Ec-centric.

On the principle of the harp, whose short strings produce the high treble notes, whose long strings give forth the deep base tones, the Saal Ec-centric, with its "center" actually *off*-center, provides a short vibrating radius for the high notes, a long radius for the rich low tones.

These exact relative proportions of vibrating area, definitely fixed by scientific principles, are provided for the first time in the Saal Ec-centric Cone. All rumble or "barrel tone" is eliminated. True balanced tone from soprano, flute and violin to pipe organ or 'cello. A demonstration will convince you.

Hear the Saal Ec-centric at your dealer's, or write us to direct you where it can be heard.

The Saal Ec-centric comes in two models: 20-inch, $25; 14-inch (Junior), $15. Slightly more west of Rockies.

The SAAL Pedestal is an ornament to the most beautiful surroundings. Its pure wooden tone chamber, three feet in length, gives exceptionally clear mellow reception. Price, $38

The famous SAAL Soft Speaker, the outstanding speaker of its type. Is giving satisfaction regardless of the set or equipment used. Standard with radio engineers. Price, $22.50

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for use with the Raytheon Tube

Thousands of these B-Eliminators have been built and are giving 100 per cent satisfaction. Dongan No. 1582 consists of 1 Transformer and 2 Chokes, designed in conjunction with Raytheon engineers. The Radio-Power supply is quiet, smooth and consistent all the time.

Built into handsome black metal case—very durable. Complete instructions for building. Send check or money order at once.

No. 147 transformer designed for use in connection with the output circuit, avoids the loss of B voltage due to the high resistance of the loud speaker and eliminates all risk of damage to the speaker. List $4.50

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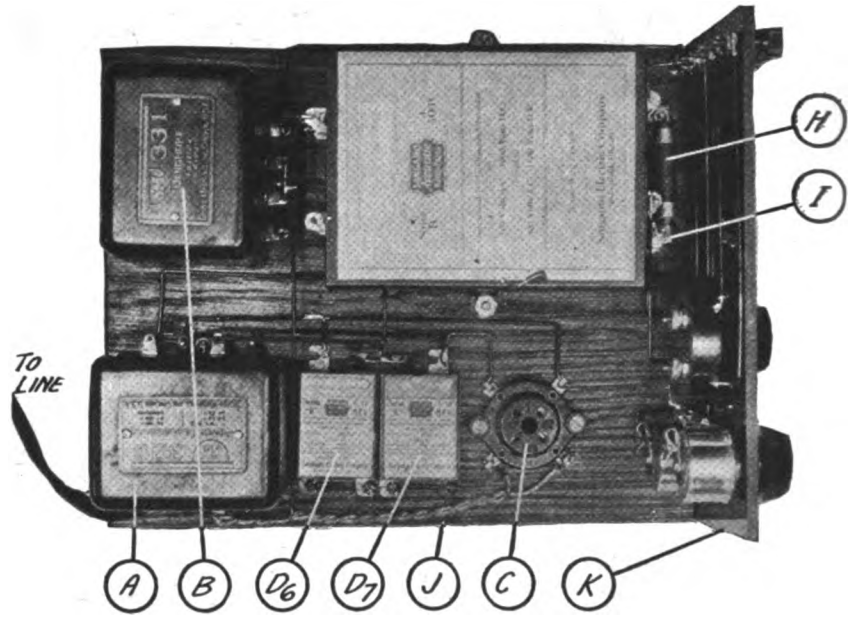
Transformers of Merit for Fifteen Years

TRANSFORMERS OF MERIT FOR FIFTEEN YEARS

How to Build the LC-Junior Power-Pack

(Continued from page 35)



THE POWER-PACK AS SEEN FROM ABOVE

FIGURE 6: *The relative positions of all the parts that are mounted on the baseboard are shown here; the parts are designated with letters which correspond with those given in the list of parts.*

How to Wire the Unit

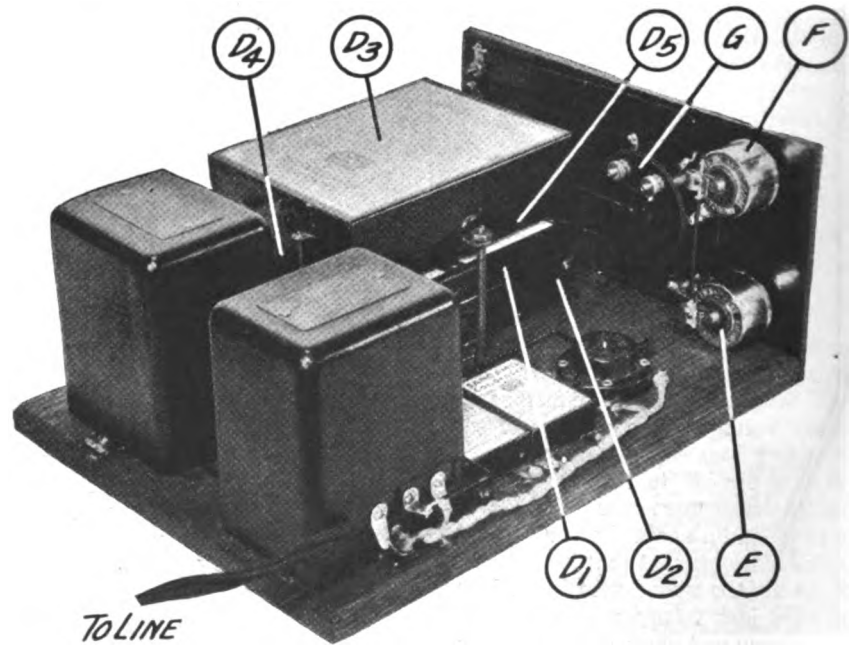
The mechanical and electrical design of this device have been worked out with extreme care through months of experiment and test. The whole unit is self-shielding; and it is due to this as well as to the electrical design of the circuit that no hum is produced in the receiving set to which it is attached.

It is recommended that all wiring be done with an insulated, solid, round bus wire.*

*The type of bus wire used in all the experimental models of this unit was "Celatsite."

Start the wiring by connecting up the leads from the transformer terminals to the condenser and socket.

Then, run the wiring to the unichoke and the remaining terminals of the condenser bank, finally finishing up with the three variable resistances and the fixed resistance and binding posts. Be sure that none of the leads touch each other. They should be spaced about ¼ of an inch wherever necessary. This completes the wiring and the power unit is ready to be installed in the cabinet.

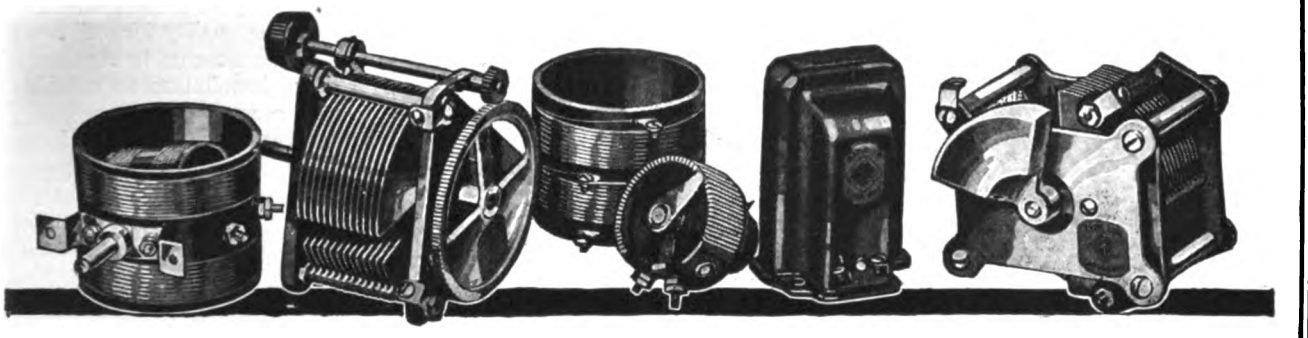


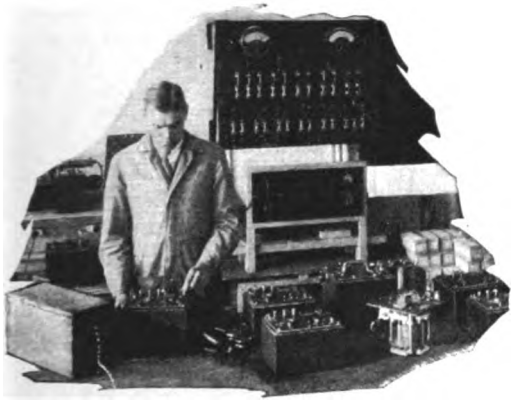
A REAR VIEW OF THE UNIT

FIGURE 7: *This picture shows the back of the panel with the three resistances mounted upon it and gives a better idea of how the condenser bank is fastened to the baseboard.*

GENERAL RADIO

Parts and Accessories have a Laboratory Background of more than a decade





For more than a decade the General Radio Company has been manufacturing radio laboratory instruments and parts—the outstanding feature of which is PRECISION. These instruments have been supplied in ever increasing quantities to many well known radio laboratories of the country, including the General Electric Company, Westinghouse Electric Manufacturing Company, Bell Telephone Laboratories, Bureau of Standards, U. S. Navy, U. S. Signal Corps, as well as the leading engineering colleges.

Today, General Radio precision instruments are standard equipment in nearly all the radio laboratories throughout this and many foreign countries.

Through the merits of design, performance, and price, General Radio instruments for the scientist or set-builder are universally recognized as the Standards of Quality.

Since the early days of radio, amateur operators and setbuilders have looked upon the General Radio Company as a time-tried producer of dependable apparatus.

The conservative buyer of radio parts looks first to the reputation of the manufacturer. He knows from his own experience and those of others whether this reputation warrants his confidence. It is this self-same confidence upon which the popular preference for General Radio parts and accessories is based.

In building a radio receiver, remember that its performance depends primarily upon two things; an efficient circuit and the use of good parts.

Wherever you find a popular circuit you will invariably find General Radio parts.

Ask your dealer or write for our latest parts bulletin No. 926.

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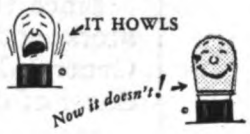

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(See page 104 for description of Sets)

Name.....

Address.....

Foreign postage 50c extra. No extra for Canada.

How to Install the Power-pack

The articles in the November and December issues of POPULAR RADIO explained at some length the installation of the LC-Senior Power-pack and the LC-Intermediate Power-pack. The first unit is a high-powered, expensive installation that is necessary only where the greatest volume is an essential. The Intermediate Power-pack is a somewhat less expensive job and furnishes an intermediate power for operation of the LC-27 receiver, or any other receiver equipped with a power tube.

The Junior Power-pack will also operate with the LC-27 receiver and furnish plenty of volume and the same type of tone quality for ordinary home use. If the diagram in Figure 1 is followed on installation no mistakes can possibly occur.

Place the power-pack in the lower part of the cabinet with the "A" supply unit, which consists of a Balkite charger and a Joyce "A" power, in position, as shown. These positions are taken from the rear.

Wire up the units exactly as indicated in Figure 3; the leads are shown in this diagram by heavy lines. The input wire from the Balkite charger should be connected in parallel with the input wires to the Junior Power-pack and these should be equipped with a switch for turning them "on" and "off" and thus supplying the "A" and "B" current to the set. The battery switch at the set should also be turned "on" and "off" when the set is put into use or turned off, as the Joyce "A" power unit continues to furnish voltage even when the AC line is shut off. When the units have finally been connected, place a UX-213 full-wave type rectifier tube in the socket in the Junior Power-pack, making sure that the pin on the tube is turned to the correct position. Then, turn on the AC switch (and the battery switch at the set) and the receiver should begin to function.

After a station is tuned in, the "C" battery control, G, on the Junior Power-pack should be adjusted, so that the tube draws the correct amount of plate current. This may be determined by placing a 50-milliampere milliammeter in series with the plate circuit of the last tube and adjusting the control, G, for the correct plate current on the last tube. Either a UX-112 type tube or a UX-171 type tube is recommended. For the maximum output, the UX-171 tube will be found preferable. This is the only adjustment to make and the unit is ready for operation continuously and should give excellent service throughout the life of the tube, which should be for a year or more.

The power unit is free from hum and will supply enough volume, when used with a receiver, to bring out all the low tones without distortion and to give really lifelike reproduction.

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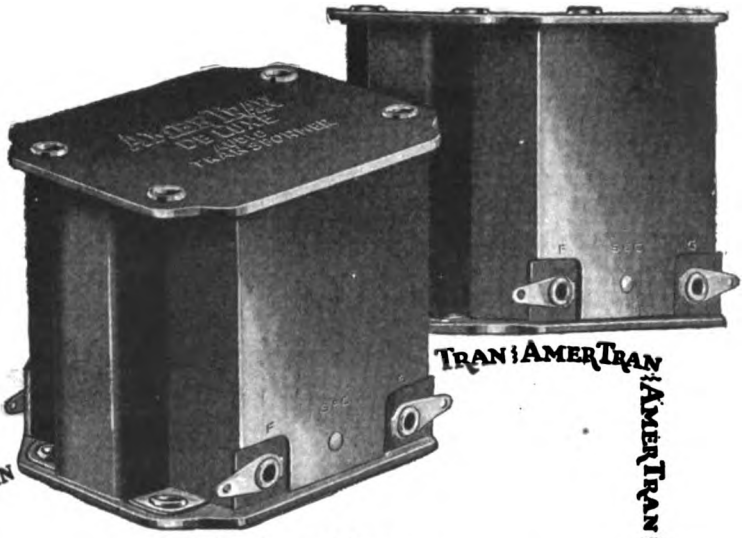
Sold only by Authorized AmerTran Dealers



The AmerTran
De Luxe Audio Transformer
Made in 2 Types
$10.00 Each

The AmerTran Power Transformer Type PF-52

Type PF-52 is intended for use in the better type of power supply developments. It will convert the standard 110 volt, 60 cycle alternating house lighting current to a higher voltage for the plate and lower voltage for filament supply. Price $18.00 Each.

The AmerChoke Type 854

This is a scientifically designed impedance or choke coil of general utility, designed primarily for use in filter circuits. As an output impedance for bypassing direct current from the loud speaker it is both efficient and economical. Price $6.00 Each.

AmerTran Types AF-7 and AF-6

AmerTran Audio Transformers, types AF-7 and AF-6, have been considered for years among the leaders in audio amplification. These popular and efficient models are made in two types—AF-7 (ratio 3½:1)—AF-6 (ratio 5:1). $5.00 Each.

Those Who Know in Radio

Those who take their radio seriously such as experienced engineers and experimenters use AmerTran De Luxe Audio Transformers. And the reasons are true tone quality and realistic reproduction which results from ideal amplification.

These men know by test and comparison that the AmerTran De Luxe makes a transformer coupled amplifier excelling all other forms of amplifiers. They know, too, how well the AmerTran De Luxe performs in Power Supply Developments. Used with other AmerTran Products, it will make a power unit capable of dependable, satisfactory service.

Every AmerTran De Luxe is manufactured to maintain a high laboratory standard. Its improved performance recommends it especially to those seeking "better than the average" radio reception.

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Delivers 40 Mils at 180 volts
All voltages are adjustable
Complete with Raytheon Tube $42.50

PIONEERING in battery elimination, Mayolian was probably the first manufacturer to adopt the now far-famed Raytheon tube as the heart of its B Supply Units, and to earn the approval of Raytheon. From that day to this, each Mayolian has been rigidly held to the standards of the Raytheon and Mayolian laboratories. Years of exhaustive research, extreme precision in manufacture, skilled supervision—all these have contributed to the pre-eminent position of Mayolian.

Today, no matter what make or type of receiver you have, there is a Mayolian to give it a continuous, uniform, noiseless "B" Supply—direct from the nearest light socket, at half the cost of burning a 25-watt lamp.

The Heavy Duty Types of Mayolian employ the new Raytheon B H tube

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The Power of Niagara—
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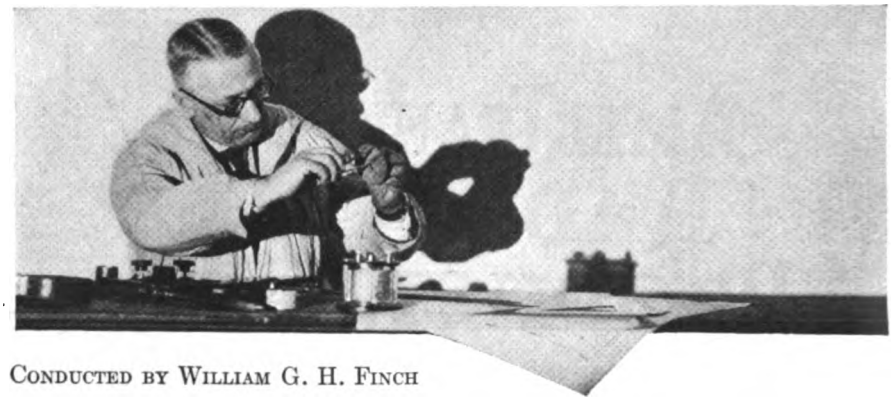


CONDUCTED BY WILLIAM G. H. FINCH

THIS *department will keep you in touch with the latest inventions of interest on which patent rights have been granted, and which are significant contributions to radio art.*

A Novel "A and B" Battery Charging Switch

PATENT No. 1,570,499, that is illustrated in Figure 1, was recently issued to John F. Keane, of Bridgeport, Conn. It describes a battery charger switch particularly designed for radio use.

The object of the invention is to provide a control switch that will permanently connect a radio set, storage "A" and "B" batteries and a charger, so that, through the manipulation of the switch, either of the batteries may be charged or the set may be connected for operation.

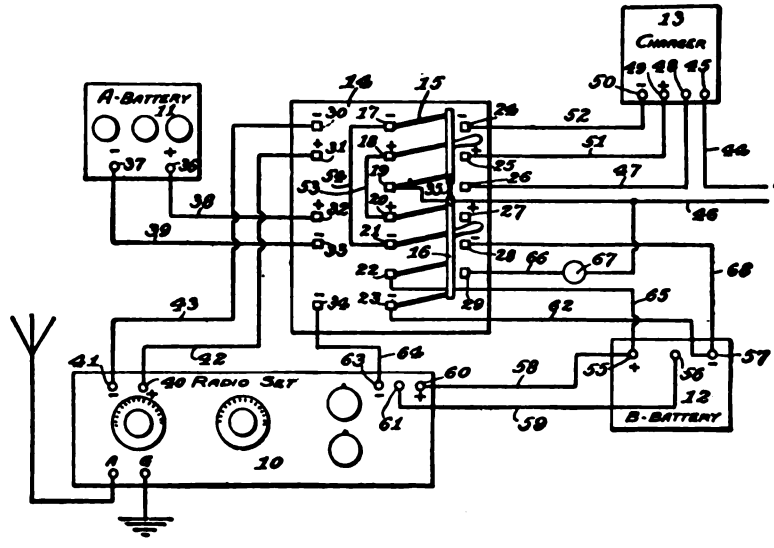
It has usually been the practice to connect the battery to the charger, and at the same time, to disconnect the set. This is inconvenient, time-consuming and open to the danger of making wrong connections which might result in damage to the set.

The present invention provides a central control switch, to which the batteries, set and charger are connected. By means of this switch the batteries may be individually connected to the charger in the proper electrical relation while the set is at the same time automatically disconnected. On the other hand when the set is electrically connected to the batteries by means of the switch, the charger is automatically disconnected.

This switch also acts as a safeguard against improper connections of the set or the charger to the batteries which might cause the tubes to be blown out, or the set to be grounded during the charging.

A Correction

ON page 96 of the January, 1926, issue of POPULAR RADIO appeared a review of patent No. 1,545,697, issued to Oscar C. Roos, for a system of eliminating or reducing static in radio reception. This review stated that the patent was applicable to radio broadcast reception. The inventor advises that the invention is successful and practical when employed in radio telegraph reception, but not in radio telephone reception. The reviewer was mislead by the language



A NOVEL BATTERY CHARGING SWITCH

FIGURE 1: *This seven-pole, double-throw switch will connect the charger to either the "A" or "B" battery or will cut off the charger and connect both batteries to the receiver as desired.*

Your program starts with a snap—

It does if your "snap" judgment is good! Because good reception demands lively batteries. And that's what you get when you snap on your Rectigon to do your charging. The time to start bringing in tomorrow's snappy program is tonight—after the last station signs off. You just plug into the light socket and attach the terminals. That keeps your batteries at their peppy best. That saves service station bother. And you'll never be caught with batteries run down, or absent for charging when the week's best program is on the air.

when you charge 'em at home with

The Westinghouse Rectigon Battery Charger

©, 1927, W. E. & M. Co.

No noise as it charges—not a bit of fuss. Not even a murmur that would disturb the mildest slumber.

No acids, no chemicals—no moving parts—nothing to spill or burn. No muss, no worry. You'll have no spoiled rugs, no ruined clothing.

Saves its cost in short order—Count the dollars spent in a few trips to the service station and you'll hotfoot it for a Rectigon, for the good it does your pocketbook as well as your batteries.

Charges both "A" and "B" batteries—Keeps both packed with power. Bulb is used for "B" battery charging and is enclosed, like all other parts, in metal, safe from accident. (Rectigon charges automobile batteries, too.)

Perfect safety for your set—If you tune in while you're charging there'll be no harm either to set or batteries. Nor will batteries be discharged if anything happens to the current while your Rectigon's attached.

No Storage Battery Radio is Complete Without a Rectigon

THE RECTIGON is a superb Westinghouse product. Things you *can't* see, like extra heavy insulation, things you *can* see, like the durably enameled case—all are of highest quality. Westinghouse also manufactures a complete line of radio instruments, and Micarta panels and tubes.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

Tune in on KDKA · KYW · WBZ · KFKX

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First in the Field Specializing in Cockaday Kits

S. HAMMER RADIO CO., 303 Atkins Ave. Brooklyn, New York

Cockaday Sets Now Made Easier to Build by Our New "Ready-to-Wire" Plan

50% of Your Time, Work and Worry SAVED!

All you need do is to connect bus-bar according to diagram, solder and your set is finished. These Kits are sent to you completely mounted, and assembled on a Veneered Mahogany baseboard and genuine bakelite panel, drilled and engraved. Genuine parts used as listed below; exactly as used in Mr. Cockaday's Laboratory Model. COMPARE OUR OFFER!

LC-27 BROADCAST RECEIVER

SENIOR AND INTERMEDIATE POWER PACKS

1	Hammarlund mid-line dual condenser, .000275 mfd.	$ 7.50	
1	Hammarlund mid-line single condenser, .000275 mfd.	4.65	
1	Precision Duo-Octoform coil set comprising one antenna coupler and two interstage couplers	10.50	
1	Amertran De Luxe first stage transformer.	10.00	
1	Amertran De Luxe second-stage transformer.	10.00	
1	Amerchoke # 854	6.00	
1	Dubilier or Tobe 4 mfd. Filter condenser.	5.50	
1	Dubilier filter condenser, .1 mfd.	.60	
1	Mar-Co illuminated control, scale 0 to 100	3.50	
2	Mar-Co small controls scale 0 to 50 and 50 to 0	1.50	
1	Carter Battery Switch	.65	
1	Samson radio-frequency choke coil # 85	$1.50	
3	Aerovox, mica fixed condensers, .00025 mfd.	1.05	
1	Durham or Daven Resistor 4 meg.	.50	
1	Lynch Grid Leak Mounting	.35	
1	Carter Gem Jack	.25	
1	Carter variable resistance, 0-10,000 ohms.	2.00	
12	Eby binding posts	1.80	
5	Benjamin UX Sockets	3.75	
1	Amperite No. 1	1.10	
	Mechanical Kit; consisting of aluminum shields, binding post strip, decorated panel and Tait brackets	12.50	

READY-TO-WIRE KIT PRICE $85.20

LC-27 SENIOR POWER PACK KIT $65.20

LC-27 INTERMEDIATE POWER PACK KIT $47.50

SILVER SHIELDED SIX KITS *In Stock Now!*

HAMMARLUND-ROBERTS HI-Q KITS

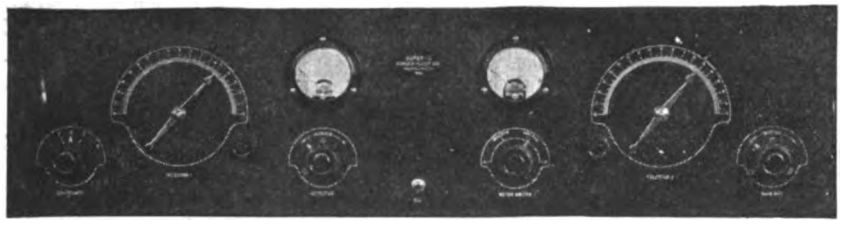
Authorized Headquarters for the NEW! KENNETH HARKNESS KH-27 Receiver

The Above Kits Can Also be Obtained Completely Wired to Specifications

Write for our interesting special circular which we have prepared on the LC-27 Receiver and above Kits.

Authorized service station for the LC-27.

DEALERS: WRITE FOR SPECIAL DISCOUNTS



A New and Advanced Model

Norden-Hauck Super-10

Highest Class Receiver in the World

Panel Size: 36" x 9" x 1-4" **Weight: 55 lbs.**

THE NORDEN-HAUCK SUPER-10 is an entirely new and advanced design of Receiver, representing what we believe to be the finest expression of Modern Radio Research Engineering. It is the product of years of experience devoted exclusively to the attainment of an ideal Broadcast Receiver—regardless of cost. Results obtained in every respect will upset all your previous ideas of good radio reception. Here are only a few of the host of features that place the NORDEN-HAUCK SUPER-10 far in advance of competition.

—10 tubes employed to give perfect reproduction with unlimited range and volume power.
—Super selectivity on all wave lengths.
—Built to Navy Standards.
—Wide wave length range—with removable coils. Adaptable 35 meters to 3600 meters if desired.
—Use Loop or Antenna.
—Simple to operate, having only two major tuning controls.
—No Harmonics. Signals are received only at one point.
—Special Power Audio Amplifier, operating any loud-speaker and eliminates necessity of external amplifier.

The NORDEN-HAUCK SUPER-10 is available completely constructed and laboratory tested, or we shall be glad to supply the complete engineering data, construction blue prints, etc., for those desiring to build their own receiver.

Upon Request Complete literature, attractively illustrated, will be gladly mailed without charge, or full size constructional blue prints, showing all electrical and mechanical data, will be promptly mailed postpaid upon receipt of $2.00.

Write, Telegraph or Cable Direct to

NORDEN-HAUCK
Incorporated
ENGINEERS—MARINE BUILDING
Philadelphia, U. S. A.

TEAR OFF AND MAIL TODAY

NORDEN-HAUCK, Inc., Philadelphia, U. S. A.

Gentlemen:—

☐ Please send me without cost or obligation on my part, attractive illustrated literature describing the new Norden-Hauck Super-10.

☐ I enclose $2.00 for which please send me, postpaid, complete full size constructional drawings and all data for building the Super-10.

Name .....

Address .....

employed in the second paragraph of the patent which stated:

"My invention relates to electromagnetic wave receiving systems."

Electromagnetic wave receiving systems defined would include both radio telephone and telegraph reception.

POPULAR RADIO is pleased with the true scientific attitude displayed by Mr. Roos in calling this correction to our attention; it is rarely that an inventor limits the scope of his own patent.

A New AC Tube

ANOTHER patent on an invention on AC tubes (No. 1,568,172) was recently granted to Frederick S. McCullough, of Wilkinsburg, Pa.

The invention aims to provide, in a cathode device of this kind, a cathode which may be heated by alternating or pulsating currents, so that ordinary house lighting current may be employed in the operation of the tubes. This cathode is so constructed that no perceptible hum or noise or current variation is produced in the circuit in which it is employed. This is due to the fluctuating field that is set up by the alternating current, provided, of course, that the voltage of the alternating or pulsating current is properly maintained with respect to the construction of the tube.

It will be seen from the illustrations, Figures 2 and 3, that the numeral 5 designates a suitable envelope containing a plate or anode 6. Inside of the anode, as usually arranged, is a grid or control electrode 7. Inside of the grid and out of contact with it is the cathode.

The cathode construction includes a body or rod, 8, which is made of porcelain or other suitable material and in which is enclosed a resistance heater, 9, that has several lead wires, 10, that extend out of the top of the tube. These wires are connected in an alternating current circuit, which may include a step-down transformer, 11, to maintain the voltage at a proper value for the construction of the tube.

Surrounding the rod and preferably tightly fitted to it, is an inner sleeve, 12, of a magnetic nature (such as nickel or copper). On the outside of this sleeve is a thin coating of heat resistant enamel or of insulation, 13. Fitted over this is an outer sleeve, 14, which is the actual cathode and which has preferably, a coating of a high emission character.

The heater wires should be co-extensive with the porcelain rod, while the inner sleeve, 12, should be slightly longer than the cathode, 14, and should extend above and below the cathode.

In operation, the tube may be connected in any standard or preferred circuit. The magnetic shield, 12, may be grounded through the lead wire, 12a. The heater is energized and this in turn heats the porcelain rod. The rod acts as a heat reservoir so that the tem-

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Which do you want Radio or Music?

WHEN you have read this advertisement you will realize that an important forward stride has been made in radio reproduction and you will be glad to have learned that, *no matter what kind, make or age of set you have*, you can now convert it in a few minutes time and at small expense into the *most perfect reproduction known to radio.*

In test after test under all conditions, before laboratory experts, set manufacturers, broadcasting artists of national fame, musical critics, and in tests by the radio public itself, the new Truphonic amplifying principle has definitely proved itself to be superior to all other methods of reproduction—barring none. And the Truphonic furthermore has the unique feature that it can be instantly attached to *any* set.

What the Truphonic Is

The Truphonic is simply this: A compact instrument containing three stages of Truphonic coupling and an output unit to protect the loudspeaker from the powerful Truphonic output. A 6 foot battery cord contains all wires to the A and B batteries (including wires for C battery and additional B battery if power tube is used). A single wire with clip attached slips over the plate prong of the detector tube which is then reinserted in the socket of the set. It is as simple as ABC and can be attached by anyone in less than 5 minutes, without any knowledge of radio.

Used in Commercial Sets

Although Truphonic amplification has been on the market only a short time it is now used in the sets of 22 radio manufacturers. Unfortunately it was not perfected in time for general use by manufacturers of large production this year. Next year the trend will be toward Truphonic amplification.

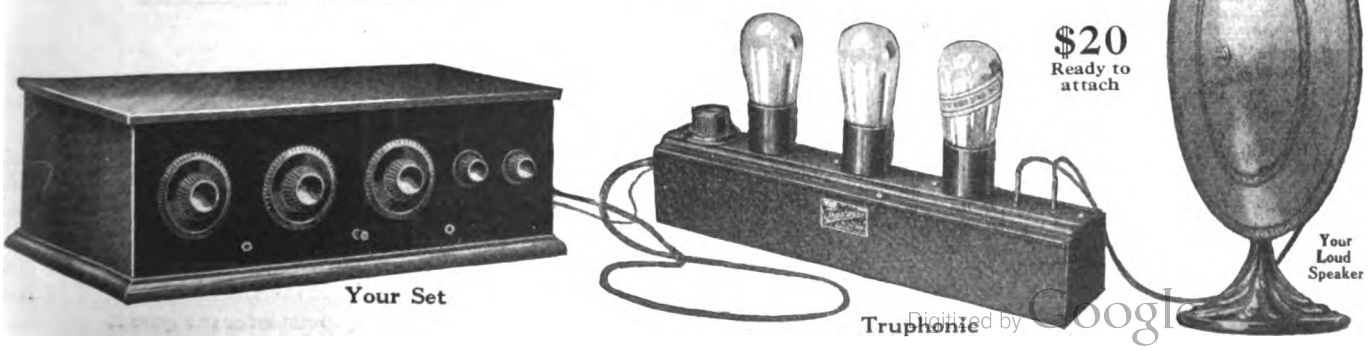
But if you want the most beautiful reproduction of music and speech in your home *right now*, get the Truphonic at your dealer's attach it, and *know* that you have the finest reproduction obtainable—no matter how much you can afford to pay.

If your dealer has not stocked the Truphonic we will send you one C.O.D. on 5 day money back trial. No Truphonic sent unless you give your dealer's name and address.

Alden Manufacturing Company
Dept. 318C Springfield, Mass.

TRUPHONIC Power Amplifier

Reg. U. S. Pat. Off.



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RADIO PROBLEMS SOLVED

POPULAR RADIO maintains for the benefit of its readers a Technical Service Bureau and Laboratory, under the personal supervision of Laurence M. Cockaday which will, without charge, answer by personal letter any question, problem or request for information submitted by a subscriber. This service is, however, also available to readers, other than subscribers, at the very nominal rate of $1.00 the inquiry.

In writing please confine your questions to one general subject, writing on one side of the paper only, and enclose a self-addressed and stamped envelope.

It is possible that your individual problem has been covered in an issue of POPULAR RADIO, and so as an aid to you we endeavor to keep a supply of back numbers in stock. The condensed index below gives a few of the subjects that have appeared recently, look this list over and if the information you want is covered, we will be pleased to supply back numbers at 35c. a copy.

January, 1926
—How to Get the Most Out of Your LC-26 Receiver.
—Some New and Useful Facts About Coils.
—When Your Set Won't Work.
—Straight-Line-Frequency Condensers.
—What's New in Radio Apparatus.

February, 1926
—How to Reduce Distortion in Amplification.
—Some Stunt Sets.
—Important Kinks in Wiring.
—How to Cut Down Your "B" Battery Bill.
—Hints for Amateurs.

March, 1926
—Why and How the Milliammeter Increases the Efficiency of Your Set.
—What "Inductance" Really Is.
—List of Broadcast Stations in the U. S.
—How to Build the S-C Receiver for Short and Long Waves.

April, 1926
—How to Get an Operator's "Ticket."
—What a Straight-line Frequency Condenser Really Is.
—How to Build a Power-pack Amplifier.
—The New "Crystal Pilot"
—How to Build and Operate a Low-Power Transmitter.
—The Popular Radio Medal for Conspicuous Service.

May, 1926
—How to Draw Up Your Own "Tuning Graphs."
—How to Build the Improved Raytheon Power-pack.
—How to Build an Antenna Mast for $15.00.
—Fifteen Ways to Reduce Static.
—Do Your Coils Broadcast?

June, 1926
—How to Build the New Home Receiver.
—How to Put Up a Good Outdoor Antenna.
—How to Get the Most Out of Your Ready-made Receiver.
—Audio-frequency Amplification. How to Get It Without Distortion.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.

July, 1926
—How to Get the Best Reception in Summer.
—The Best Crystal Set for $13.00.
—How to Build the Newest Portable "Town and Country" Receiver.
—Four New Combinations of Units for Assembling the Raytheon Power-Pack.
—How to Get the Most Out of Your S-C Receiver.

August, 1926
—A New Method of Using Harmonics for Determining Frequencies.
—Popular Radio Circuits.
—How to Build the Improved Browning-Drake Receiver.
—How to Pick Out a Loudspeaker.
—How to Get the Most Out of Your "Town and Country" Receiver.
—Three Vacuum Tubes in One.

September, 1926
—Foretelling Radio Reception from the Weather Map.
—How to Build an Impedance-coupled Amplifier.
—A Radiant Crystal Pilot.
—Popular Radio Circuits.
—How to Simplify Your Set with Automatic Filament Controls.
—Inside Information on New Radio Receivers.
—How to Wire Your House for Radio.

October, 1926
—How to Build the New LC-27 Receiver
—The Radio Road Hog
—Popular Radio Circuits
—Sets That Earn Incomes.
—Inside Information on New Radio Receivers.
—Why Signals Fade.

November, 1926
—How to Build the LC-Senior Power-Pack.
—Waves and Wavelengths.
—Popular Radio Circuits.
—How to Select Your Radio Parts.
—How to Patent Your Radio Inventions.
—How to Solder.

December, 1926
—Uncle Sam's New Short-Wave Net.
—How Circuit Resistance Affects Selectivity.
—POPULAR RADIO Circuits.
—How to Build the LC-Intermediate Power Pack.
—Inside Information on New Radio Receivers.

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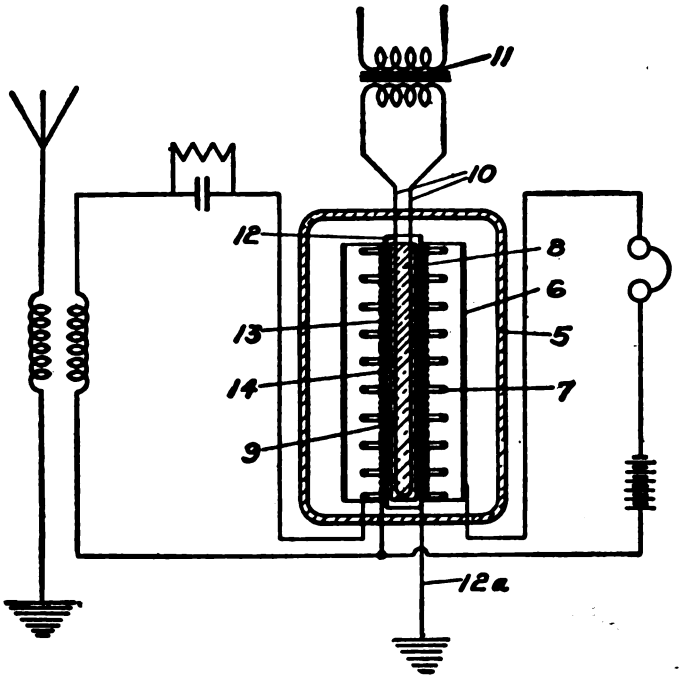


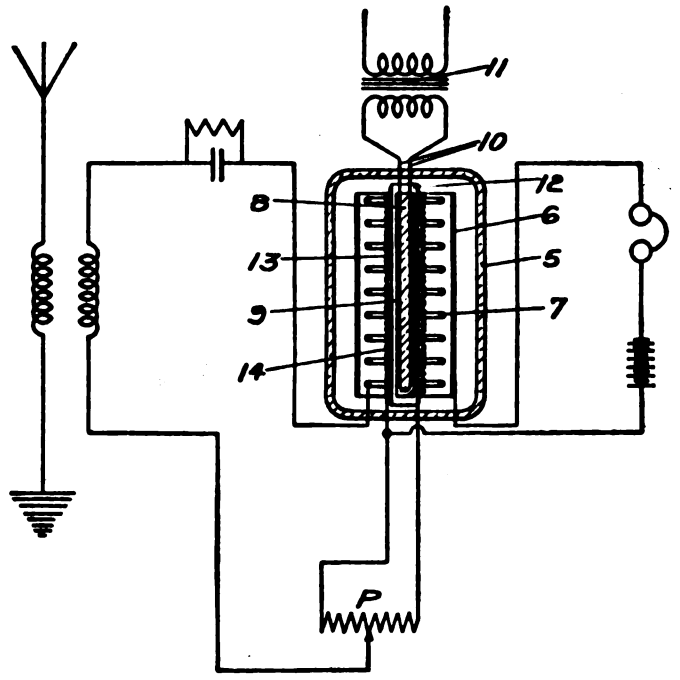
THE AC TUBE USED IN A SIMPLE CIRCUIT

FIGURE 2: *The porcelain rod, 8, contains the AC heater wires, 10; the coated cathode, 14, however, is the actual electron emitter. The envelope, 5, contains a plate, 6, inside of which is a grid, 7. The voltage is maintained at a proper value by means of the transformer, 11.*

perature of the cathode will not fluctuate with the maximum and minimum current values in the alternating heating circuit. The heat from the rod will be conducted through the inner sleeve, 12, to the outer sleeve or cathode, 14, raising it to an efficient emitting temperature.

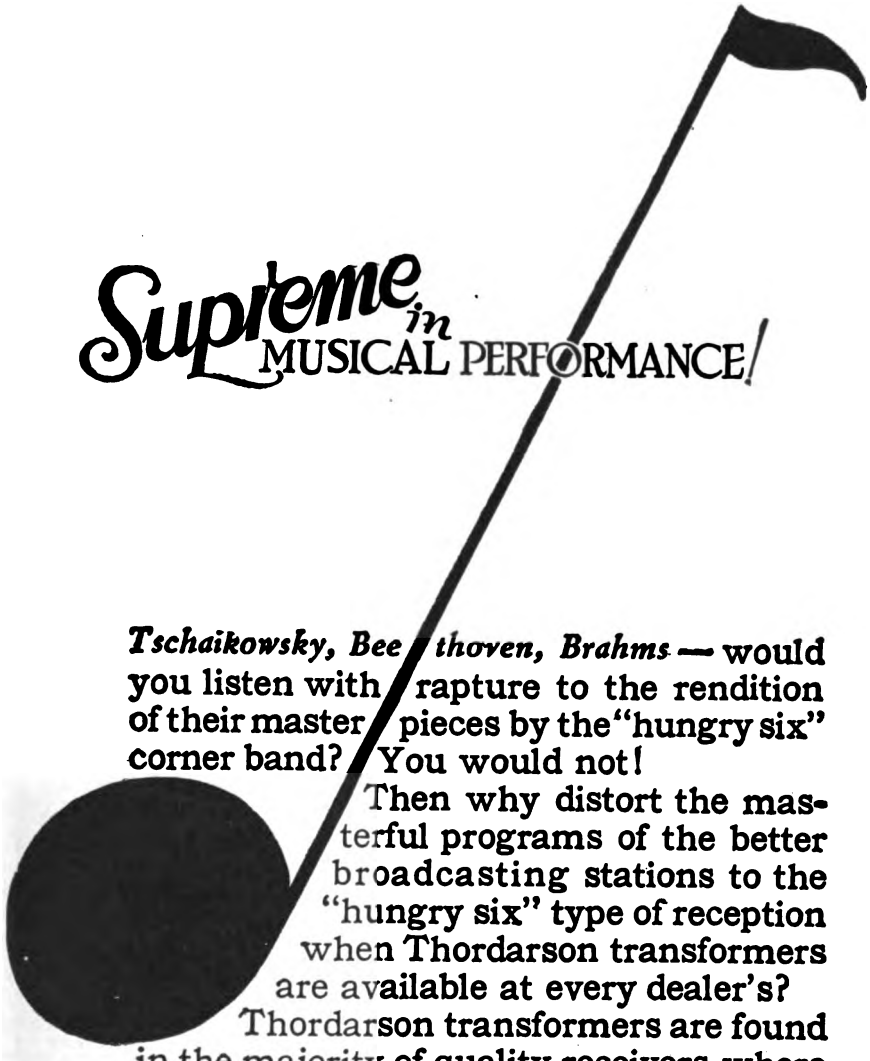
If the voltage in the heater is properly proportioned to the construction of the tube, the magnetic shield, 12, will prevent the oscillating field that is produced by the alternating heater current from affecting the operation of the tube in any manner. For this reason no hum or alternating current fluctuation is apparent in the tube circuit. The grounded shield eliminates any generation of eddy currents in the cathode and neutralizes the capacity between the heater wires and the cathode.

Instead of grounding the magnetic shield, it may be desirable to connect the cathode and the shield through a potentiometer, P, as shown in the illustration (Figure 3).



A MODIFIED CIRCUIT FOR THE AC TUBE

FIGURE 3: *Here, the magnetic shield, 12, is connected through the potentiometer, P, to the cathode, 14, instead of being grounded as in Figure 2.*



Supreme in MUSICAL PERFORMANCE!

Tschaikowsky, Beethoven, Brahms — would you listen with rapture to the rendition of their master pieces by the "hungry six" corner band? You would not!

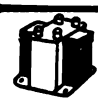
Then why distort the masterful programs of the better broadcasting stations to the "hungry six" type of reception when Thordarson transformers are available at every dealer's?

Thordarson transformers are found in the majority of quality receivers, where musical performance is the first consideration—A conclusive proof of the musical supremacy of Thordarson amplification.

THORDARSON RADIO TRANSFORMERS

R-200
Amplifying Transformer

The transformer for the musical epicure. Has unusually faithful reproductive powers. Specified on such quality receivers as Zenith, Kennedy and Howard... $8.00



Standard Amplifying Transformer

A good reproducing transformer suitable for the requirements of the average ear.

2 to 1 ratio..... $5.00
3½ to 1 ratio..... 4.00
6 to 1 ratio..... 4.50

Autoformer All Frequency Impedence Amplifier

Amplifies every note in the musical scale. An impedance with a step-up ratio, giving the even amplification of the impedance with the amplification increase of the transformer..... $5.00

R-210
Power Compact

A complete foundation unit for power amplification and B-supply. Contains a power supply transformer and two chokes for power amplifier using UX-210 power tube..... $20.00

R-171
Power Compact

Similar to the R-210 type but designed for UX-171 power tube and Raytheon rectifier. Contains buffer condensers as well as power supply transformer and chokes..... $15.00

R-197
Power Supply Transformer

A Power Supply Transformer designed for B-supply using the R. C. A. UX-213 type full wave rectifying tube. Will supply up to 180 volts B..... $7.00

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30 Henry Choke

Designed either as a filter or an output choke. Completely shielded. Current carrying capacity 80 MA. Inductance 30 henries. D. C. resistance 280 ohms..... $5.00

R-76
Speaker Coupling Transformer

An output transformer designed as a protective device to keep the high direct current voltage of power amplification out of the speaker unit..... $6.00

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Transformer Specialists Since 1895
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30 Days Free Trial

Just Out—1927 Model

Yes Sir! You can put a new 1927 Westingale Radio in your home and use it to your heart's content on 30 Days' Trial. Listen to music, concerts, news, sports, market reports from stations all over the country. Compare it with old style 3 or 4 dial sets costing more, then if not convinced that Westingale gives you the greatest Radio satisfaction and the best value for your money, **you don't have to keep it.**

New ONE Dial Radio

$57.00 Retail Price

NOW! Westingale offers the last word in Radio. Either 1 or 2-Dial Control — easiest to tune and years ahead in powerful reception and tone. Newest period type cabinets, two-tone walnut finish. The front panel embossed in dull gold with artistic Spanish Galleon design. Unbeatable for performance, appearance or price.

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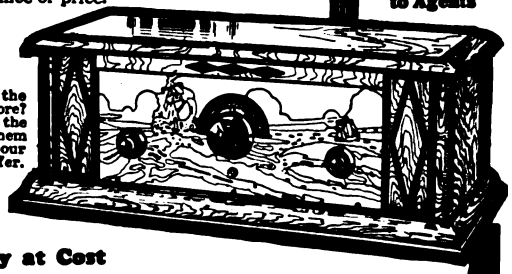
Where else can you get so much for the money on 30 days trial? Why pay more? Why take chances? Why not have the NEWEST Radio when you can try them at our risk. Before you buy get our Free Catalog and 30 Day Trial Offer.



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We want to appoint agent or dealer and place one Westingale Demonstrating set in each locality. Get demonstrator at big discount in price and on 30 days' trial, and make $50 to $100 a week as our representative. Our Free Book tells how.

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New *Vitalitone* Ship Model Cone Speaker

Not a picture, but a real model of a ship sculptured by a foremost artist—and finished in antique polychrome—powered with the wonderful Vitalitone Unit and Cone—We are the pioneer manufacturers of cone speakers—and know what you want—Here it is.

"SUPREME QUALITY AND BEAUTY"

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Vitalitone Radio Corporation

88 University Place, N. Y., U. S. A.

The obverse of the medal; this original is two-and-one-half inches in diameter.

The Popular Radio Medal *for* Conspicuous Service

TO every radio amateur, to every amateur experimenter and broadcast listener, who is instrumental in alleviating human suffering or saving human life, directly through the medium of radio, recognition will hereafter be extended in the form of a medal that shall be known as "The Popular Radio Medal for Conspicuous Service." This medal is unique within the realms of radio in that it shall be awarded, not for scientific achievement or invention, but for service to humanity.

To insure a fair and unbiased consideration of all claims, a Committee of Awards has been appointed that includes five distinguished citizens of international fame. To assist this Committee of Awards, an Advisory Committee has been appointed that numbers among its members some of the most eminent citizens of the United States, including representatives of many of our most distinguished institutions.

The conditions under which the medal will be awarded are here specified:

1. The medal shall be known as the Popular Radio Medal for Conspicuous Service.
2. The medal shall be awarded, without discrimination as to sex, age, race, nationality, color or creed, to those radio amateurs, radio experimenters, broadcast listeners and other non-professionals through whose prompt and efficient action radio is utilized to perform an essential part in the alleviation of human suffering or in the saving of human life within the territorial confines of the United States and its possessions, or in the waters thereof.
3. The medal shall be awarded by a Committee of Awards that shall not exceed five in number. No member of this Committee shall be an employee, officer or stockholder of POPULAR RADIO, INC., nor shall any such employee, officer or stockholder have a vote in the deliberations of the Committee.
4. An advisory Committee, which shall cooperate with the Committee of Awards and which shall be particularly charged with the responsibility of making recommendations for awards of this medal, shall be made up of men and women who, because of their interest in the public welfare or because of their connection with institutions that are consecrated to public service, are in positions to bring to the attention of the Committee of Awards the exploits of candidates who are within their own special fields of activity.
5. The medal will be awarded for services rendered since Armistice Day, November 11, 1918.
6. Recommendations for awards may be submitted to the Committee of Awards at any time and by any person. Every recommendation must contain the full name and address of the candidate, together with a detailed account of the accomplishment on which the proposed award is based, and must be accompanied by corroboratory evidence from persons who have first-hand knowledge of the circumstances and whose statements may be verified to the satisfaction of the Committee of Awards.
7. The medal will be awarded to as many individuals as qualify for it and at such times as the Committee of Awards may authorize.

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The reverse; the name of each recipient will be engraved in the space provided.

8. All considerations not specified herein shall be left to the discretion of the Committee of Awards.
All communications to the Committee of Awards may be addressed to—

The Secretary of the Committee of Awards, POPULAR RADIO Medal for Conspicuous Service, 627 West 43rd Street, New York.

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A Safety Valve for Your Radio

SUPPOSE the battery wires to your radio set became crossed, accidentally, what would happen? Almost anything from a serious fire, due to overheated wires, to a ruined B-Battery or a burned-out tube. The consequences are serious enough to warrant some careful thought right now!

The cheapest insurance against the dangers of crossed wires is to protect your radio set with a Belden Fused Radio Battery Cord. It provides

1—An A-battery fuse.
2—A B-battery fuse.
3—A polished bakelite cover for the battery fuses.
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5—A color-code on each wire for identifying each circuit.
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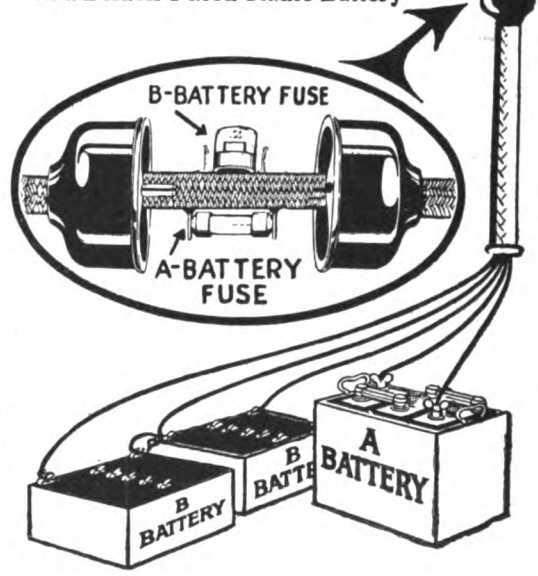

Eliminate fire hazard, ruined or discharged batteries, and burned-out tubes. Ask your nearest dealer for a Belden Fused Radio Battery Cord, today!

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WHEREVER a resistance is specified pin your faith on

CLAROSTAT

the greatest variable resistor!

That's what 59 leading B eliminator manufacturers are doing. After exhaustive tests, they are convinced that only CLAROSTAT acts as the perfect voltage control because . . .

it has a range of from practically zero to 5,000,000 ohms . . .

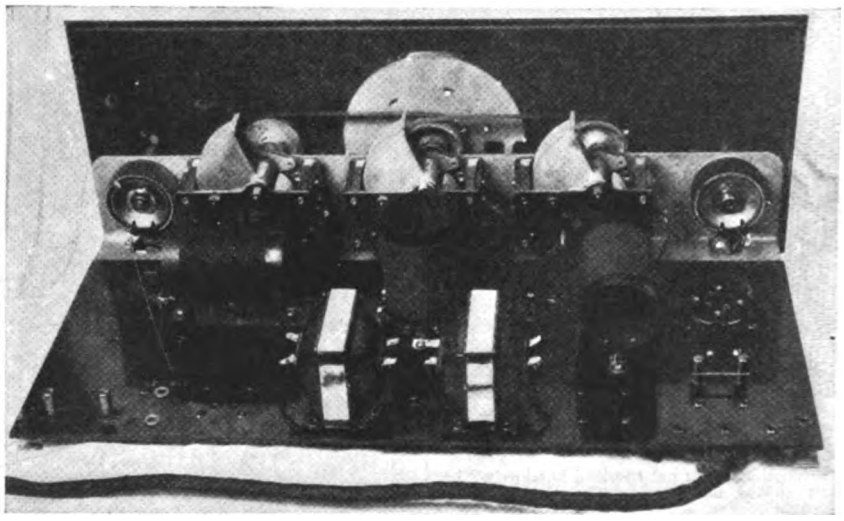
has a current carrying capacity of 20 watts —greater than that of any variable resistor—*without the slightest danger of packing, arcing or crackling noises.*

Have you sent for your copy of "The GATEWAY TO BETTER RADIO"? The edition is limited and you can't afford to be without it. 32 pages covering everything—reception, transmission, amplification and battery elimination Send 25c in stamps or coin to Dept. PR.

American Mechanical Labs.
285 N. 6th St., B'klyn, N. Y.

What's New in Radio

(Continued from page 42)



The three condensers of the new Stewart-Warner set tune the second and third radio-frequency stages and the detector circuit; note how they are connected together by a band to enable the three circuits to be tuned by a single control.

coupled together mechanically to operate from the single tuning knob on the front panel.

The size of the antenna used with the Stewart-Warner Receiver is not at all critical. If the receiver is used in congested districts where there are two or more local broadcasting stations, the antenna should not exceed eighty feet in length, because, under these conditions, maximum selectivity is essential. In suburban locations or in any place where there are no nearby broadcasting stations the antenna may be up to 150 feet long. A small, indoor antenna works well with this receiver and will provide ample volume on all local and semi-local broadcasting stations.

The manufacturers also offer their own make of vacuum tubes and strongly urge the use of these tubes in this receiver. The recommended tube equipment for the receiver is, therefore, six of the Stewart-Warner Model 501-AX tubes. Or, if the owner desires to use a power tube in the last stage of audio-frequency amplification, a standard UX-112 tube will be found suitable for this purpose.

The receiver may be operated from batteries or the operating current may be drawn from the alternating-current, light lines through a suitable power-pack. If batteries are used, the equipment should consist of a 6-volt storage "A" battery and 90 or 135 volts of dry-cell "B" battery. A small dry-cell "C" battery of from 4½ to 9 volts is also required.

If power-packs are used to convert the house-lighting current to a form suitable for operating the receiver, it will be necessary to have an "A" power-pack capable of delivering at least 1½ amperes at 6 volts or, where a UX-112 type power tube is used in the last stage, the "A" supply unit must deliver 1¾ amperes at 6 volts. The "B" power-pack should deliver at least 90 volts and preferably 135 volts or higher; and taps should be provided to supply the lower voltages for the detector and radio-frequency amplifier tubes. Some "B" power-packs are also designed to supply the necessary "C" voltage. Where this is not done it is necessary to use a separate "C" battery.

The receiver has ample selectivity and sensitivity to meet all normal demands. In a test of this set, made in New York City, a number of Western and Southern stations were tuned in through the locals with really good reception and without interference. The set could not be made to squeal or oscillate.

Maker: Stewart - Warner Speedometer Company.

A New Inductively Tuned Receiver

Name of instrument: The Kellogg "Model 507" receiver.

Usage: For general broadcast reception.

Outstanding features: Inductive tuning. Tremendous volume. Good tone quality. Artistic appearance. Easy to operate.

Description: The Kellogg "Model 507" receiver is a six-tube set consisting of three stages of tuned-radio-frequency amplification, a vacuum-tube detector and two stages of transformer-coupled, audio-frequency amplification. Tubes of the UX-201-a type are used throughout except in the second stage of audio amplification, which employs a UX-112 type power tube.

The panel is of wood, finished in dark walnut, and bears a modest etched design which serves to break the monotony of the otherwise plain surface. The four operating control knobs are grouped on a decorative bronze plate which is located in the center of the panel.

The entire receiver is inclosed in an artistic walnut cabinet which matches the front panel of the receiver in coloring. The finish is soft and is enriched by shading which gives a pleasing high-light effect. The same receiver unit may be obtained in either a high-boy, console cabinet (as illustrated) or in a smaller table-mounting type of cabinet.

Power to operate the receiver may be supplied from "A," "B" and "C" batteries, or may be drawn from the

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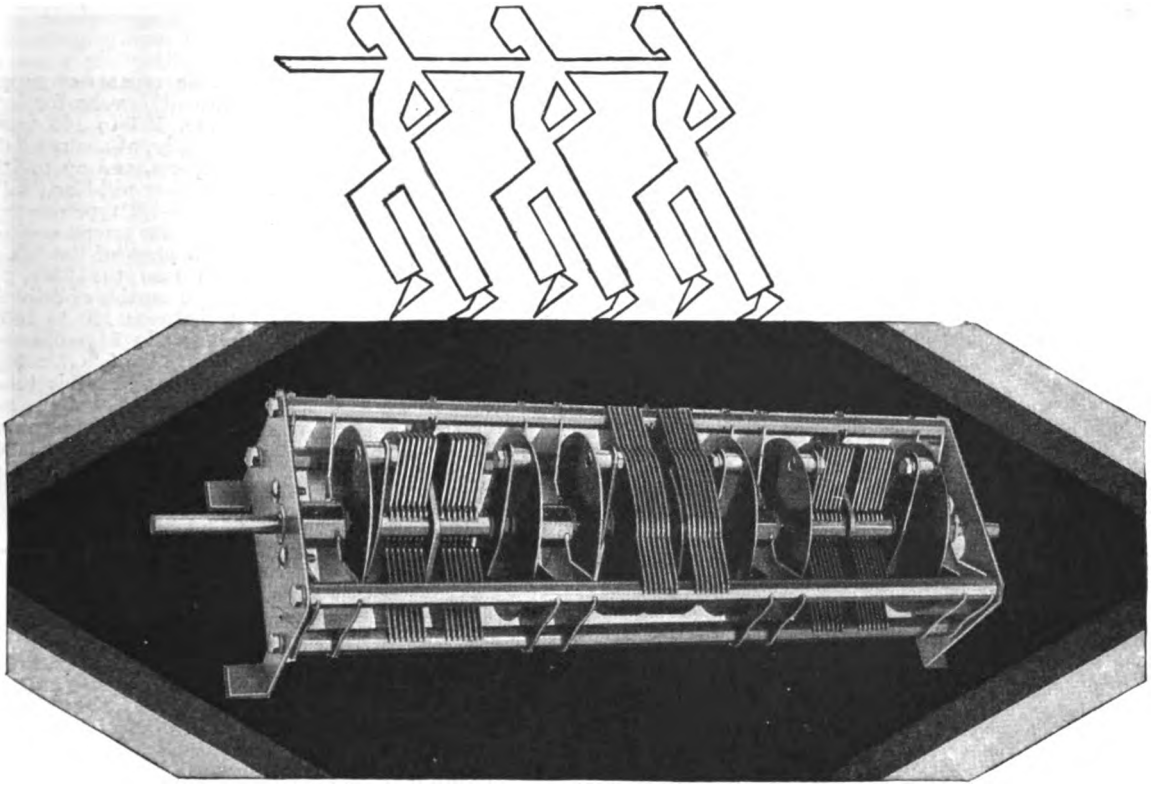

THEY WORK AS ONE

It is a simple matter to mount three condensers on one shaft—but, sad to relate, they won't necessarily work as one.

Enter — Standardization, mechanical genius, electrical measurement—and the gang condenser problem is solved.

The new 3-gang AMSCO Allocator is an electrically accurate condenser for Simplified Control. It makes one-dial tuning really practical—not a theory.

Each of the matched units is a modified frequency condenser (straight tuning line) designed to allocate the stations in accordance with wave-length divisions.

They work—as One!

AMSCO Allocating Condensers are also furnished Single or Siamese—allocating by Frequencies (S. F. L.), by Wavelengths (S. T. L.), or by capacity variations (S. C. L.). Write for descriptive leaflets.

AMSCO PRODUCTS, INC.

Broome & Lafayette Streets New York City

AMSCO

AMSCO ALLOCATING CONDENSERS

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A tube may be bright but DUMB!

TEST YOUR TUBES WITH THIS HANDY TESTER THAT TELLS WHETHER THEY'RE

"good", "fair" or "poor"

A tube that lights may be low in efficiency and pulling the life out of your "A" battery. And, that single run-down tube is often the entire cause of weak reception. Get this reliable testing instrument, the Sterling Tube Tester, and be sure of the condition of your tubes. Don't guess!

This tube tester tests the amplifying value of both large and small tubes, including power amplifiers and 300-A detectors. Simple to operate. No computations to make.

See your dealer and also write for our interesting 32 page booklet—G—on care and upkeep of radio.

R-411 Home Tube Tester for 201-A and 301-A tubes, including power tubes, Price $7.50.

R-400 Home Tube Tester for 199 and 299 tubes, price $8.50.

Sterling
Home Tube Tester

THE STERLING MFG. COMPANY :: :: :: :: Cleveland, Ohio

THE FAMOUS IVEYLINE CABINET

Why Pay a Fancy Price for LC-27 Cabinets?

Sloping front, piano hinge and lid support, rubber fect. Made to Author's design.

Mahogany finish..$7.50
Solid Walnut.....9.50
f.o.b. Hickory. Cash with order.

	Mahog. Fin.	Solid Walnut
7″ × 18″ × 10″	$3.50	$5.00
7″ × 21″ × 10″	3.75	5.25
7″ × 24″ × 10″	4.00	5.50
7″ × 26″ × 10″	4.75	6.25
7″ × 28″ × 10″	5.50	7.00
7″ × 30″ × 10″	6.00	8.00

When we say Solid Walnut we do not mean a poplar or gum back and bottom.
Nickeled full length piano hinge and lid support.
Finish: Three coats of lacquer rubbed to a glossy polish.

A Baseboard Free With Each Cabinet

Prices f.o.b. Hickory—CASH WITH ORDER.
We ship practically all orders on same day as received.
Send for Free Catalogue Showing Our Piedmont Line also.

THE SOUTHERN TOY COMPANY, INC.
Hickory, North Carolina

house-lighting lines through the use of special power-packs. If power-packs are used in place of batteries, they should be of recognized makes and should be capable of supplying 1¾ amperes at 6 volts for lighting the filaments, 135 to 165 volts for the plate supply, at a current drain of 25 milliamperes, and up to 12 volts for the necessary grid-bias ("C" voltage).

The UX-171 type power tube may be used in the second audio-frequency stage, in place of the UX-112 type. In this case the "B" power-pack should be capable of delivering somewhere between 150 to 180 volts, at approximately 35 milliamperes. At least 45 volts of "C" voltage should be available where this tube is used, and it must be variable so just the proper amount may be applied. The use of the UX-171 type power tube is practical only where the plate voltage is supplied by a power-pack because the current requirements of this tube make the use of dry-cell "B" batteries impractical.

The manufacturer of this receiver strongly recommends the use of an antenna not more than 80 feet in length and not less than 60 feet. The receiver is balanced for use with an antenna of this size. Directions are given in the instruction booklet by means of which the receiver may be adapted to an antenna of any length by the addition of a small fixed condenser in the antenna circuit.

The circuit used in the Kellogg receiver is an unusual one. Fundamentally, it employs the new "RFL" method of balancing out undesirable feedback. This represents only one feature of the circuit used, however. The Kellogg engineers have worked out many other features which are incorporated in the design.

Another feature is the fact that tuning is accomplished by *varying the inductance* of the four tuned circuits, rather than by varying the capacity. This is accomplished by winding each of the coils in two parts, and arranging them so that one part rotates inside of the other. As the inner part of the coil is rotated the inductance of the whole changes gradually, thus

The rear view of the Kellogg receiver showing the set assembly with the tubes in place and the loudspeaker installed in the upper portion of the cabinet.

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providing the necessary tuning effect.

Ordinarily, the technical features of the tuned circuits are of little interest to the owner of a manufactured receiver, but in this case this novel tuning feature presents especial interest to the lay owner of the receiver as a complete 180 degree turn of the main tuning control covers a waveband not exceeding 100 meters in width, instead of a band 350 meters wide. There is an auxiliary tuning knob which is a simple rotary switch with seven points. When this switch is set on the first point the receiver is capable of receiving over the waveband from 200 to 230 meters. That is, a 180 degree variation of the main control will tune the receiver through a very narrow band of approximately 30 meters.

When the auxiliary control is moved to the second point the receiver may be tuned through the band between 230 and 270 meters by a 180 degree rotation of the main tuning control.

The result of this arrangement is that the broadcasting stations are well spread out over the tuning dial. Instead of KDKA and WAHG coming in only one or two degrees apart on the tuning dial, as is the case with the average receiver, they are separated by about 12 degrees on the dial of the "507" receiver. And other stations which come in almost on top of one another on the dial of the average receiver are separated several degrees on the dial.

In addition to the single, wavelength-tuning control and the auxiliary waveband switch, already mentioned, there are two other minor controls provided on the panel of this receiver. One is a volume control which permits the adjustment of the volume of any incoming signal from maximum down to zero. This operates under the usual scheme of increasing or decreasing the filament current to the filaments of two of the radio-frequency amplifier tubes.

The other control is a rheostat in the filament circuit of the other four tubes.

The coils in each of the tuned circuits are individually inclosed in shields to limit undesirable interstage coupling and external pick-up. Openings are provided in the sides of the shield "cans" to accommodate the two shafts which simultaneously control the movable coils and the switches in the four circuits and which are operated by the main and auxiliary tuning controls on the panel of the receiver. Such an arrangement is of course necessary when four circuits are to be tuned by a single knob as in this set.

All of the instruments which make up this receiver are mounted on a substantial sub-base which in turn is supported on a wood foundation. The panel is attached to this sub-base by means of two metal brackets. The two filament control rheostats are mounted directly on the panel, but the two shafts which are geared to the two internal control shafts, project through the panel without being fastened to it. The tuning knobs are then attached to the outer ends of these shafts.

Maker: Kellogg Switchboard and Supply Co.

PURCHASER—What is the charge for this battery?

RADIO MAN—One and one-half volts.

PURCHASER—Well, how much is that in American money?

—*American Boy*

KH-27 KIT

Used by Kenneth Harkness

WITH the *special* parts in this official foundation kit and a few standard parts, easily obtainable in any radio store, you can build an exact duplicate of the KH-27 Receiver designed by Kenneth Harkness. Foundation kit contains:

1—Drilled and engraved front panel, 7 x 26 ins.
1—Drilled sub-panel, 7 x 25 ins., with six tube sockets attached.
2—KH bakelite mounting brackets.
1—Brass condenser shaft, 9 ins. long.
3—KH-27 Coils, including antenna, second stage and detector couplers.
3—KH Twin-choke Audio Couplers.
1—KH Output Filter Choke Coil.
1—Instruction folder, prepared by Kenneth Harkness, with directions for assembly and pictorial step-by-step wiring diagrams.

Bakelite front and sub-panels are completely drilled for mounting *all* parts. Pictorial instructions make wiring easy and success certain.

KH-27 KIT $49.50

If your dealer cannot supply you send check or money order to address below. Kit will be sent you immediately.

AMAZING TONE QUALITY

The K. H. 27 gives marvelously clear and realistic reproduction at all frequencies. Mr. Harkness spent two years of research in audio frequency alone in order to achieve this perfect audio combination. The first and only set to use the new patented "Twinchoke" audio amplification. A real distance-getter too. Gets distance night after night. Perfect selectivity—no interference. Easy to operate—no whistles or squeals. The latest and greatest Harkness circuit.

Send for this booklet

Send 25 cents to address below for a copy of "How to build the KH-27" with complete description of circuit, photographs of set, list of parts, assembly directions and step-by-step wiring diagrams.

TWINCHOKE Audio Coupler

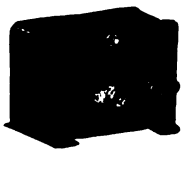
—used in the KH-27

The pure, realistic tone quality of the KH-27 is obtained by the use of three KH "Twin-choke" Audio Couplers. This new, patented coupling unit, quadruples power output of each tube enabling Twinchoke amplifier to handle *four times as much volume as any other amplifier without overloading*. This means perfect tone quality with ordinary tubes.

You can use Twinchoke couplers in *any* set—the set you now have or the set you are going to build. Connects just like a transformer. Either two or three stages can be used. Complete instructions and circuits with each coupler. Length—3". Width—2". Height—4⅛". If dealer cannot supply you, order direct.

$7.50 Each

Output Filter Choke Coil



—used in the KH-27

Especially designed for output filter circuits to protect loudspeaker and insure perfect reproduction. Designed for 171 and 210 tubes. Improves tone quality with 201A or 112 tubes. Fits under sub-panel—less than 2 inches in height. Can be used with any amplifier or set. Instructions enclosed.

$5.00

TWINCHOKE Power Amplifier Kit

JOBBERS and DEALERS
Write For Discounts

This kit contains three KH Twinchoke Audio Couplers and one KH Output Filter Choke Coil—the essential parts for a three-stage Twin-choke amplifier. Kit includes complete instructions for building separate amplifier or incorporating amplifier in a complete set. Special price,

$25.00

KH Radio Laboratories Inc.
124 Cypress Avenue, Bronx, N.Y.

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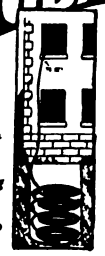
SUBANTENNA!



The One Great New Thing In Radio

Amazing New UNDERGROUND ANTENNA

Gets Distance Clearly

Here you are, "Distance" fans! Install this new type underground "pick up system." Get distant stations loud and clear. SUBANTENNA so greatly reduces static and all other air noises that it lets the broadcast come thru clean and pure.

Reduces Bothersome INTERFERENCE

Power line leaks, arc light crackles, STATIC and other such nuisances as have made distance reception unpleasant, do not bother the "listener-in" with a SUBANTENNA. And you forever get rid of the unsightly mess of wire on your roof.

Opens Up New, Greater Amplification Possibilities

Instead of keeping your power turned way down to avoid amplifying foreign noises equally with the broadcast, you can now use the full power of your set to advantage. No matter how much amplification you choose to use, broadcast will so far dominate the air noises that the latter will be of no consequence.

FREE TRIAL OFFER!

Nothing else is like SUBANTENNA. It is not "just a wire." But you must try it to fully appreciate the wonderful new significance it gives to Radio. You can try it at our risk. Write at once for scientific explanation and for particulars of our FREE TRIAL OFFER. Write now. No obligation.

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Building Your Own 3 Foot Cone?

—choose cone material carefully

grain; therefore it has no resonance point of its own, but resonates uniformly at all frequencies.

THERE is just one product made especially for the cones of cone type speakers—Alhambra FON-O-TEX. It is used by practically all the leading cone speaker manufacturers, because it produces tone quality far superior to papers or other substitutes for Alhambra FON-O-TEX.

This remarkable product has practically no

Price 75c for a sheet 38 x 38 inches—large enough for a 3 foot cone. Ask your dealer. If he hasn't Alhambra FON-O-TEX we will supply you. To the cost of the number of sheets you need add $1.00 for packing, f. o. b., N. Y. C.

The SEYMOUR Co., Desk 101
325 West 16th Street
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ALHAMBRA
FONOTEX
PRODUCT AND PROCESS PATENTED
FOR CONE TYPE LOUD SPEAKERS

To Dealers:

Parts for 3 ft. Cone Speakers are the most demanded radio items of the day. If you are not carrying them do so at once. Write us for names of jobbers who stock Alhambra FONOTEX.

If we have no jobber near you we will supply you direct until we have.

The SEYMOUR CO.
325 West 16th Street, New York City

Who Pays the Broadcaster?

(Continued from page 15)

But what does all this cost?

The cost of the programs—aside from the station toll charges—are matters of conjecture; information concerning the prices paid for broadcast artists varies greatly, and is generally regarded as confidential.

Perhaps the most costly programs are those of the Atwater Kent Hour, the A and P Gypsies, the Balkite Hour and the Eveready Hour which have been estimated as high as $500,000 a year, including the toll charges.

The total cost of the Eskimos, engaged for the Clicquot Club Company's program, is $202,800 a year; the performers probably cost about $400 an hour. Orchestras such as the Silvertown, which is sponsored by The Goodrich Tire Company and the Ipana Troubadours, sponsored by Bristol-Myers Company, manufacturing chemists, probably cost from $400 to $500 an hour. The popular Goldy and Dusty during their period of contract, are said to have cost the Gold Dust Corporation about $250 an hour. The Royal Orchestra, supported by the Royal Typewriter Company, must cost from $500 to $650 an hour. No figures have been given out about the costs of broadcasting the special concerts of New York Symphony Orchestra, but each appearance at the studio probably costs Fansteel Products, Inc., which maintains the Balkite Hour, from $3,000 to $4,000. The nine concerts of the Cleveland Symphony Orchestra, sponsored by the Sandusky Cement Co., cost that company about $2,500 each. The Bristol-Myer program for some months cost at the rate of a total of $107,000 a year. The Happiness Boys are said to cost the Happiness Candy Stores, Inc. about $400 for each weekly appearance.

Artists such as McCormack and Galli-Curci, who have appeared on programs sponsored by the Victor Talking Machine Company, would ordinarily charge about $5,000 for an appearance, although, because of their connections with the Victor Company, it is probable that they charged little or nothing, taking their remuneration in the form of commissions on the stimulated sales of their gramophone records. On occasions, well known artists, such as appear on the Eveready and Atwater Kent Hours, for example, get fees ranging from $1,000 to $2,500 for an appearance before the microphone.

The Eveready Hour (which is said to be the oldest regular broadcast feature in the field, dating from December, 1923) costs the National Carbon Company an average of from $5,000 to $6,000 a week; this sum includes the toll charges as well as the costs of employing regularly a sixteen-piece orchestra, six singers and occasional great artists.

It may be parenthetically observed that the value to the artists of a broadcast appearance is becoming an important factor in the economic scheme of the radio industry. The Happiness Boys, for example, are receiving $2,500 a week for their appearance in vaudeville—a value that has been created entirely by their popularity with the radio audience. And the Goodrich Silvertown orchestra unit, including the Silver Masked Tenor, is getting $3,000 a week on the Keith-Albee vaudeville circuit. These artists established their professional value through their appearances before the microphone. It is this creation of values that must be taken into account by the artists when they contract for appearance in the broadcast studio.

Charges for Network Stations for Hours After 6 P.M.

Station	*Location*	*Charge Per Hour*	*Charge Half Hour*	*Charge Quarter Hour*
WEAF	New York	$480.00	$300.00	$187.50
WEEI	Boston	350.00	218.75	136.72
WCSH	Portland	170.00	106.25	66.41
WTAG	Worcester	170.00	106.25	66.41
WJAR	Providence	170.00	106.25	66.41
WGR	Buffalo	230.00	143.75	89.84
WLIT	Philadelphia	210.00	131.25	82.03
WRC	Washington	210.00	131.25	82.03
WCAE	Pittsburgh	210.00	131.25	82.03
WTAM	Cleveland	180.00	112.50	70.31
WWJ	Detroit	230.00	143.75	89.84
WSAI	Cincinnati	240.00	150.00	93.75
WLIB, WGN	Chicago	350.00	218.75	136.72
WOC	Davenport	170.00	106.25	66.41
WCCO	Minneapolis	250.00	156.25	97.66
KSD	St. Louis	250.00	156.25	97.66
WDAF	Kansas City	220.00	137.50	85.94
	TOTAL:	$4,080.00	$2,550.00	$1,593.77

NOTE: The day time charge (before 6 P.M.) for groups of stations is one-half of the evening charge for a like period of time.

DISCOUNTS: A contract based on weekly usage is subject to 5 percent discount for six months, 10 percent for nine months and 15 percent for twelve months.

The toll charges of your favorite program feature may be estimated from this rate card—provided you know the number of stations in the chain and the length of the program periods.

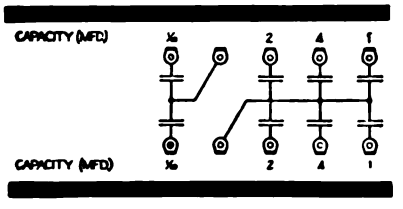
Faradon

CAPACITORS

"UNIVERSAL" FILTER CAPACITOR BLOCK

Model WS-3750

$10.50



This new FARADON "Universal" Filter Capacitor Block, of 14.2 Mfds. in one container, is for operation in connection with the most generally used Battery Eliminator circuits. It contains important features not heretofore found in grouped filter condensers.

The total capacitance is connected to fixed terminals in convenient units, permitting ready wiring as desired. Units to be connected in the circuit where possible high potential surges may occur are constructed to withstand a higher voltage than is usually required. Convenience, safety and continued satisfactory operation are combined in the FARADON Filter Block.

BY-PASS CAPACITORS

Capacity MFD	Operating DC	Models Flash Test DC	Model No.	Price
½	150	500	WS3713	$ .90
1	150	500	WS3714	1.20
2	150	500	WS3715	1.90

RELIABILITY

Is essential to Satisfaction in By-Pass and Filter Capacitors.

Not until a product has successfully passed exacting final electrical and mechanical tests is it considered worthy of the "FARADON" trade mark and ready for commercial use. Dependable, efficient products are the result.

U. S. Army, U. S. Navy, Bureau of Standards, General Electric Co., Radio Corp. of America, Tropical Radio Telegraph Co., Westinghouse Electric & Mfg. Co., and Western Electric Co., are some of the large Faradon users.

Secure the reliable Faradon Capacitors from your Dealer.

WIRELESS SPECIALTY APPARATUS COMPANY

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Aside from the feature of economy, there is the thrill and satisfaction that comes from building your own receiving set.

Thousands of sets have never been constructed because of the atmosphere of mystery that has enveloped the whole subject of radio. Kendall Banning, Editor, and Laurence M. Cockaday, Technical Editor of POPULAR RADIO through their close contact with the great radio public sensed this and compiled a book that will convince the veriest beginner that technical training is not essential. If you have a little time to devote to a most fascinating pastime, send for a copy of "How to Build Your Radio Receiver."

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POPULAR RADIO is full of helpful suggestions as well as instructive and entertaining articles on radio and allied scientific phenomena. This information is supplemented by an advisory service that is free to all subscribers. Any problem you encounter that is not answered in the book or magazine will be answered by personal letter if you will submit it to the Technical Service Bureau.

A Valuable Combination

For the next thirty days we will give you a copy of "How to Build Your Radio Receiver," FREE and enroll you for all privileges of the Technical Service Bureau at no further expense, on receipt of your remittance of $3.00 in payment for a 12 months' subscription for POPULAR RADIO. (As an alternative offer, if you wish the combination with POPULAR RADIO for 7 months only—send but $2.00). In any event, you run absolutely no risk as we will refund in full if you are not more than satisfied with your purchase.

CONTENTS

In "How to Build Your Radio Receiver" you will find complete constructional diagrams, specifications, photographs and instructions for building the following sets. Each has been selected as representative of its circuit because in laboratory tests it proved the best for distance, selectivity, tone volume, simplicity of construction, ease in tuning, reliability and all-around satisfaction.

A $5 CRYSTAL SET
THE HAYNES SINGLE TUBE RECEIVER
A TWO-STAGE AUDIO-FREQUENCY AMPLIFIER
THE COCKADAY 4-CIRCUIT TUNER
A 5-TUBE TUNED RADIO-FREQUENCY RECEIVER
THE "IMPROVED" COCKADAY 4-CIRCUIT TUNER
THE REGENERATIVE SUPER-HETERODYNE RECEIVER

POPULAR RADIO
627 West 43d Street, N. Y. C.

Offer expires Jan. 31st, 1927

POPULAR RADIO, Dept. 15A,
627 West 43d St., New York City

Enclosed remittance of $3.00 is payment in full for a 12 months' subscription for POPULAR RADIO and copy of "How to Build Your Radio Receiver" FREE.

Name.....

Address.....

City..... State.....

☐ Check here and remit $2.00 if you prefer POPULAR RADIO for 7 months only in combination with "How to Build Your Radio Receiver."

Herbert

A PORTABLE SET FOR USE IN WAR

A new German invention is this portable radio receiving and transmitting apparatus, set into an armored side-car of a motorcycle. The radio apparatus is housed in a case which serves the dual capacity of protecting and shielding. The equipment for both transmitting and receiving is entirely self-contained and is ready for use by simply opening the door of its case.

BROADCAST LISTENER

Comments on radio programs, methods and technique —from the point of view of the average fan

By RAYMOND FRANCIS YATES

Musicians Are Better Heard Than Seen

AT a time when television is imminent and the absence of vision over the radio is lamented, Leopold Stokowski, the able conductor of the Philadelphia Symphony Orchestra, agitates for the total concealment of the musicians during concerts.

Mr. Stokowski argues—and perhaps logically enough—that music to be properly appreciated, should be unattended with the sight of the source.

His psychology is no doubt sound, for what can the presence of the performers do but divide the impressions between two senses? As a matter of fact it is best appreciated with the eyes closed and the four other senses held in abeyance. Distractions must be excluded.

What, pray tell us, does the mere sight of a frantically animated conductor or a group of swaying violinists add to the music? Do we need to see the bird to be enraptured with his song? Or the frog to sense the lonesomeness of his croaking? Is not the radio, after all, a blessing in that it spares us sight of the source? What a sorrowing disillusion it would be to see the faces back of many of our best radio vocalists!

Say what you will, Mr. Stokowski has to our way of thinking voiced a sensible bit of psychology. Not that we are silly enough to lament the approach of television, but we do hold that television, insofar as it gives us sight of musical performers, is a totally unnecessary embellishment. Time and time again, we have sat before our cone with eyes closed that we might exclude even this unoffensive piece of paper during a particularly delicious bit of music.

We crave realism to be sure but not at the price of distraction.

An Important Trifle

WE'RE just a little cross and you'll probably think we're a silly old crab when we tell you what it is about; time and trouble are laying a heavy hand on us these days, and the little things that tolerant youth used to laugh off, annoy and sting. There was a time back in the green days of the art when we were thrilled when WJZ whirled off a phonograph record—and here we are crabbing because the microphone switches of some of our studios click when they are manipulated!

Time was when these extraneous and unnecessary noises would have passed unnoticed, but broadcasting is getting to be a big boy now and it must watch more closely its P's and Q's.

Perhaps this little protest may serve as an index to the progress the art has made since KDKA'S raspy wave poured over an amazed land.

The next time you go to your radio listen for the little click that comes with the switching in and out of the microphone. You won't hear it listening to the better regulated studios (WJZ and WEAF for instance) but the haywire outfits still have it.

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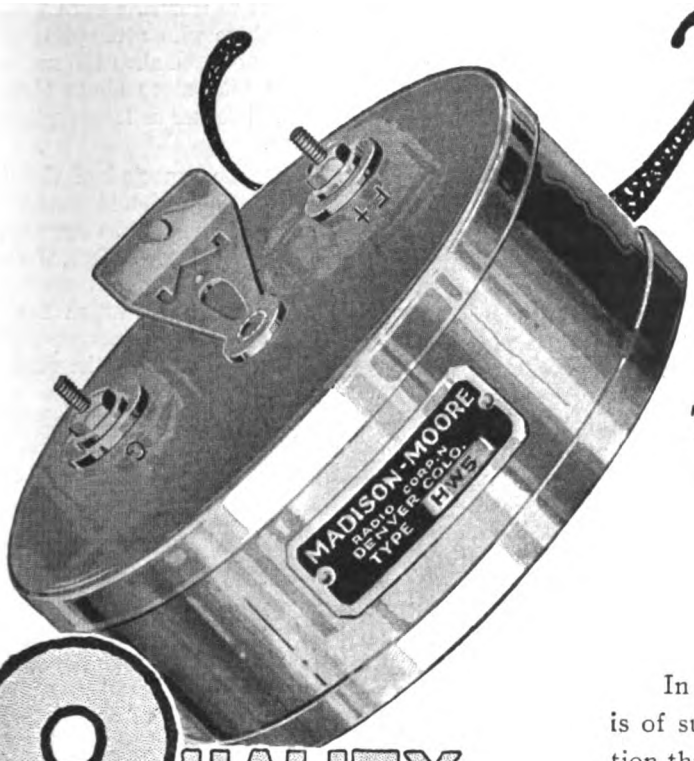

New.

THE TRANSFORMER THAT INSURES RECEPTION AT ONE POINT ONLY ON THE DIAL. *THIS HAS NEVER BEEN DONE BEFORE.*

THE MADISON-MOORE *One-Spot* TRANSFORMER

JUST OUT!

QUALITY

SELECTIVITY

DISTANCE

In this new instrument, the intermediate frequency is of such high value that the reappearance of any station throughout the entire broadcast range is eliminated. Reception at more than one point on the dial, the feature that has annoyed every owner of a set, has been completely conquered by this latest radio engineering achievement.

This new MADISON-MOORE *ONE-SPOT* TRANSFORMER is even more wonderful than its predecessor, because it gives POSITIVE SELECTIVITY, HIGHER QUALITY, and GREATER DISTANCE. Yet, owing to increased production, the price for the new instrument is lower than for the former model.

Surpassing radio satisfaction is yours if you install MADISON-MOORE *ONE-SPOT* TRANSFORMERS. They are supreme in the realm of Radio.

Ask your dealer. If he can't supply you, write us.

MADISON-MOORE RADIO CORPORATION
2524 B Federal Boulevard
Denver, Colorado—U. S. A.

MADISON-MOORE

The Finest **RADIO APPARATUS** *in the World!*

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The House of All Popular Kits

EVERY KIT INCLUDES FULL INSTRUCTION SHEETS FOR WIRING

NEW IMPROVED DIAMOND OF THE AIR
5 Tube Kit, Complete Parts, $37.50
Licensed Under Armstrong Patent 1,113,149
Manufactured by Clapp Eastham Co.
Exclusively for the Bruno Radio Corp.

BERNARD SIX KIT
ONE FINGER CONTROL — COMPLETE PARTS ... $40.00

HAMMARLUND-ROBERTS Hi-Q ..... Complete parts $63.05

DAVEN BASS NOTE 5 tube. $65.00

New and Improved BROWNING-DRAKE 5 tube $65.90

HENRY-LYFORD RECEIVER $69.50

LC-27 $85.20

KARAS EQUAMATIC $88.70

S-M SHIELDED "6" $95.00

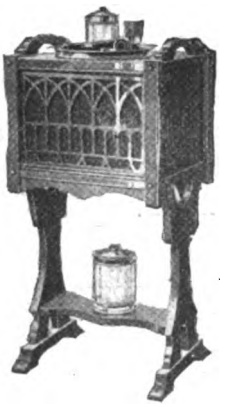
AND OTHER POPULAR KITS, ELIMINATORS, SPEAKERS, ETC.

Always in Stock

Acme Ceco General Radio
Aero Electrad Silver-Marshall
Bruno National Samson
Bodine Dubilier And others

Send for Catalogue

B. C. L. RADIO SERVICE CO., Inc.
221 Fulton St. Dept. P N. Y. C.



Announcing

the first of a series of new models of

TIMBRETONE
REG. U.S. PAT. OFF.

Combined with the utility of a smoking stand is a loud speaker. Carry it about and have it where you want it—on the porch or along side of your easy chair.

Sales offices

SANFORD BROS.

CHICAGO . . . . 30 W. Walton Pl.
CHATTANOOGA . . . 615 Broad Street
SEATTLE . . . . . Am. Bank Bldg.
SAN FRANCISCO . . . 311 Minna St.

Factory: TIMBRETONE MFG. CO. Hoosick Falls, N. Y.

The Good and Evil of Musical Scenarios

WHEN the Eveready Hour first made use of the musical scenario some two years ago, broadcasting was supplied with an inspiration which it has since feasted upon with the avidity of a long-starved dog.

Yet the employment of the scenario as an aid to better and more formal programs was a perfectly obvious thing to do—so obvious, indeed, that one is surprised that the service was not used long before. It was the only logical way in which a program could be formulated systematically and contemplated with the caution necessary to achieve something more than mediocre results.

That many other broadcasters were quick to see in the musical scenario an aid to more thorough work was natural and a bit encouraging, but that they should persist in applying the scenario to all sorts of advertising schemes is a trifle disconcerting. Even a most cursory survey of the present situation reveals many annoying irregularities in the musical scenario business. Those in charge of radio advertising seized upon the idea as a means of working into their programs supposedly subtle and adroit references to their wares.

That these references have been neither subtle or adroit, or even decently cognizant of the listeners' intelligence, does not need to be testified to by this Department. It was only a few nights back, that the Bryers Ice Cream Company attempted to seduce us with the enactment of an annoyingly obvious manuscript wherein we were constantly reminded of the convenience, nay, the utter necessity of this delectable delicacy. And Bryers is but a single offender; there are dozens of them.

To our way of thinking the practice is becoming obnoxious. Yet all of this was to be expected of the wise young copy artists who want to please their bosses.

While Mr. Stacey, the imaginative impressario of the Eveready Hour, supplied the original inspiration, he by no means supplied the bad example of making a thorough-going advertising prostitute of the radio scenario. Indeed, Stacey from the start put the thing on a lofty pedestal. Not once did he attempt to dramatize the life of a "B" battery or to induce his audience to buy the products of the National Carbon Company. In this his judgment was sound and there is the unquestioned success of the Eveready Hour to prove it. Not once did he cheapen his acts by even a flashing reference to the products of his company.

The continued indiscretion on the part of the over-zealous copy artists will, eventually, make of the radio scenario a thing to be avoided by all those who have a sincere desire to entertain the air audiences. Not alone that, but it tends to frustrate even the best efforts of those who attempt to make honest use of it. Unless the radio audience can take more abuse than we think, it will sooner or later register its annoyance.

It was to be expected of the copy writers that they should ravish the scenario once its value was demonstrated. It is, as a matter of fact, the only other practical device that can be resorted to as a substitution for the straight, iron-bound, announce-it-play-it program that makes up the woof and warp of broadcasting.

Up until the time the hundred-dollar-a-week *literatti* embraced it, the idea promised one day to emerge as a highly developed sub-art. Stacey showed the temper of the thing a dozen times. The "Assassination of Lincoln," "Evangeline," and "The Show Boat" was enough to establish for all time the legitimacy of the idea. True, Stacey's object was not wholly laudable for he, too, was seeking to establish good will, but he was sensible enough to know that he could create a lasting impression only by making his shows so delightfully entertaining that they would survive the general run of trash.

Given free reign, the new school of hack radio scenarioists will make of themselves an intolerable nuisance. As time goes on, they will become more daring and even less painstaking. We shall soon be listening to advertising dramas wherein animated boxes of breakfast food will launch themselves into plots designed to convince you that you really should have more mineral matter in your diet and that your general health and well being depends pretty much on the nature of your morning food.

It was but a short time back that the New York Edison Company staged an air play around a group of electrical conveniences, and "The Old Lady Who Lived In A Shoe" has long since been exploited by a kiddie shoe house over the radio.

We have had enough of it to know that these word merchants of the third-rate agencies will, unless checked, attempt to turn radio into a national medium.

We can expect little aid from the studio censors of the toll stations; they are the safety valves that pop only when the possibility of court action or ridicule looms up. To the public, they hotly claim that it is their earnest desire to keep the radio holy and pure, but to the advertisers they are willing to extend co-operation that stops just this side of insulting the audience of listeners in.

It is a question not how much can the public be entertained while it is being exploited, but rather how much can it be exploited while it is being entertained.

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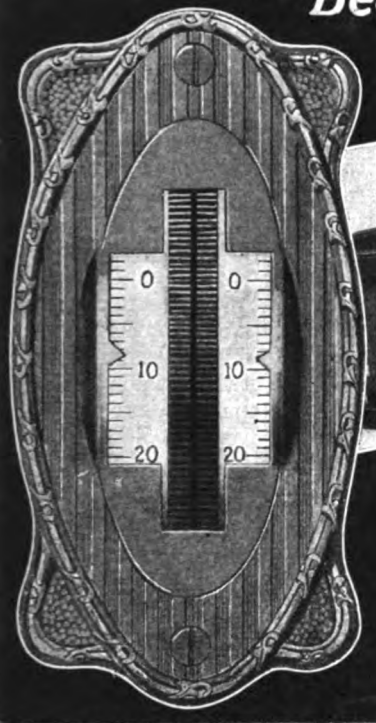
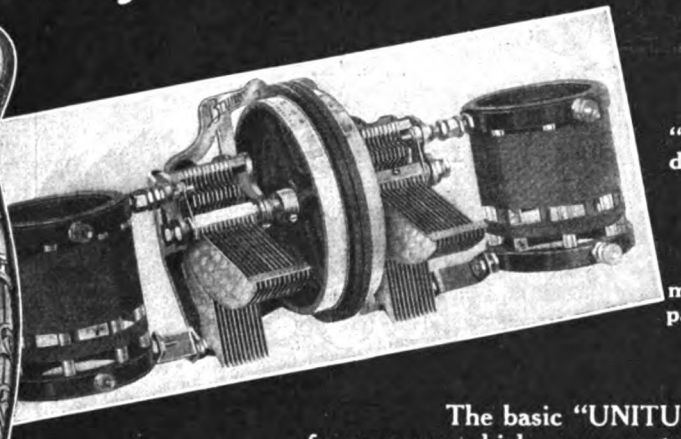
THE **Simplicity** of tuning
THE **Efficiency** of the Bakelite Shaft Condensers and Quatzite Coils
and the **Beauty** of the Bronze Front Plate

"Bruno" UNITUNE THE HEART OF THE CIRCUIT





Makes the "UNITUNE" the most desirable tuning device ever designed.

ALL BRUNO "UNITUNES" may be mounted on a panel with only two screws.

The basic "UNITUNE" consists of a frame upon which are mounted two condensers operated independently by two bakelite drums projecting thru a beautiful bronze plate. It may be obtained in all standard capacities. Completely assembled it lists at $11.00.

Other "UNITUNES" assembled with one or more Quartzite Coils for all popular circuits range from $12.00 to $21.00.

Booklet of Instruction and Blue Prints—25c

BRUNO RADIO CORP., LONG ISLAND CITY, N. Y.

POPULAR RADIO
5 MONTHS FOR $1.00

To double our list of subscribers, we will for a limited time accept $1.00 as payment in full for a five months' subscription for POPULAR RADIO. This offer is open to new subscribers only. Tell your friends about it. They will appreciate this money saving opportunity to secure POPULAR RADIO promptly and regularly each month.

The convenient coupon gives other attractive offers good for either new or renewal subscriptions.

POPULAR RADIO
627 West 43rd Street
New York City

Date.....1927.

POPULAR RADIO, Dept. 17,
627 West 43d Street,
New York City.

Enclosed is remittance of $....., payment in full for subscription order for POPULAR RADIO as checked below.

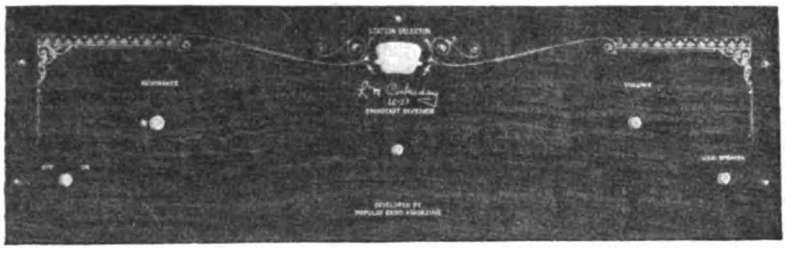
- ☐ 5 months for $1.00 (new subscribers only)
- ☐ 7 months and "How to Build Your Radio Receiver" for $2.00.
- ☐ 12 months and "How to Build Your Radio Receiver" for $3.00.
- ☐ 12 months and Set of "Simplified Blueprints" (see page 104) for $3.00.
- ☐ 24 months for $5.00.

Name.....

Address.....

City.....State.....

Save Money on Your Panels



Illustrating the New Cockaday LC-27 Size 8 x 26. Drilled and Decorated **$3.70 RETAIL**

"VEE DEE"
Metal Art Panels for Successful Kits
The Latest Improved and Technically Perfect

L. M. Cockaday—LC-27
Browning-Drake Improved
Hammarlund-Roberts Hi-Q
Silver-Cockaday
Karas Equamatic
Samson-DeLuxe
Infradyne-Remler Type
Bremer-Tully Power Six

Highest degree of special finishes—in wood grains, bronze duo-tones and high lighted novelty effects. Drilling work precise to the thousandth part of an inch. Steel of lowest carbon content.

Every special panel includes vulcanized fibre bushings for best insulation.

Lowest Prices ***Most Liberal Terms***

Selling Manufacturing and Jobbing Trade Only

THE VAN DOORN CO.
160 N. LaSalle St., Chicago, Ill. **Factories: Quincy, Ill.**

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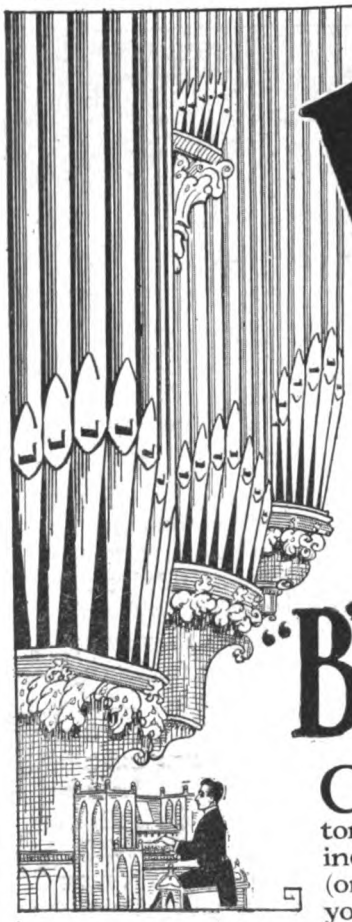

Power for the deep tones PLUS a "B" Eliminator

COMPLETE realism in radio reproduction requires that the deep bass tones as well as the high notes be prominently brought out. Only a UX-210 (or CX-310) tube, using up to 400 volts in your last audio stage, has sufficient power to do this. To use this tube directly in your set, rewiring would be required to take care of the increased voltage. Now by merely attaching a POWERIZER and eliminating your present last tube, you can not only use this real power tube without rewiring, but eliminate "B" batteries as well.

POWERIZER operates from the lamp socket, using two power tubes—one the 210 or Super-Amplifier giving such marvelous tone that it has come to be known as the "Tonifier," the other a UX-216 (or CX-316) rectifying tube, making the POWERIZER a heavy duty super "B" eliminator.

You cannot KNOW what really perfect tone quality is until you hear POWERIZER. POWERIZER can be attached to any set in a few minutes with no technical knowledge whatever. Ask the nearest POWERIZER dealer to demonstrate it to you today.

Our new descriptive leaflet, "New Tone for Old," will gladly be sent upon request. Write for it.

POWERIZER

REG.

TESTED and APPROVED by ALL Leading Laboratories

Power Amplifier and "B" Eliminator combined — at cost of good "B" Eliminator alone.

$49.50

Radio Receptor Co.

106 Seventh Ave. New York

A Word About "Fresh" Announcers

THERE is no practice on the air more vicious than that of fresh announcing.

When it comes to announcing, we belong to the fundamentalist group and the old blackjack of this Department is always ready to sock a dissenter.

Just now our special murderer is hot on the trail of an exceedingly fresh young man who displays his wit (*sic*) before the microphone of WWRL. This chap is the leader of air rowdyism, for rowdyism it is—nothing more and certainly nothing less. His flow of tinseled vulgarity is sustained for fifteen minutes at a time and his stuff is perhaps the most banal and the most trashy of anything we have to listen to.

This freshy might be a wow at a smoker, but there is no place on the air for such tommyrot. Broadcasting has enough to overcome without living down such encumbrances.

Will the "Canned Music" Return?

THAT there is a possibility of canned music returning to the air might upset those of our readers who recall the early use of gramophone records.

It has been months and months since a gramophone has been connected to the air, yet, if we read the stars rightly, this source of entertainment may be well on its way back. Many researches have passed under the bridge since last we heard the scratchy bellowing of the old type of reproducers; since that time the recording and reproduction of sound has been carried to a point where the most subtle effects and the most reluctant frequencies have been "canned," and not a mite of their pristine beauty is lost in the re-creating process. Electrical recording and reproduction based on the new physics of horn amplifiers has brought new hope for the talking machinery and radio.

Our smaller and less conspicuous broadcasters could well afford to use some of these new records. How much better they would be than even the best efforts of amateur talent used by many studios! Perhaps, after all, we are not too presumptious in looking forward to the days when special records will be prepared and released for nominal sums to the smaller studios, much as movies are released today. With all of the good talent being attracted to the better stations, it will only be a matter of time before the little radiator will find itself without an audience. It is finding itself in competition not only with better talent but with stations that have sufficient power to carry the entertainment of this talent right into its home territory. The day will soon be here when the better radio features will be carried to every corner of the U.S.

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Are Announcers "Hampered" by Studio Rules?

IN a recent statement to the press, a New York announcer whose cerebral measurement would be a hot subject for discussion at a congress of anthropologists, whined that he had been hampered in his efforts to improve broadcast presentations by studio rules.

A year ago this smarty was free to say what he would in introducing performers and, like others of his class, he became nothing short of obnoxious with his cheap humor and lengthy vocal excursions into subjects about which he knew nothing. Now that this particular studio to which he had been attached had muzzled him, he found his style cramped and he has intimated that the art was going to the bow-wows.

Imagine broadcasting going to the dogs because it is getting conscious enough to measure the damage that a lot of fresh young jackanapes have been doing to it by their nonsense!

That this young man should be forced to make such a statement is indeed encouraging and it seems to prove that sensible men have the upper hand.

A New Ham Practice

IT took a long time for the hack studio managers to find something to replace the reading of "coming over fine" telegrams, as a device to solicit the response of yokel listeners, but the great problem was finally solved.

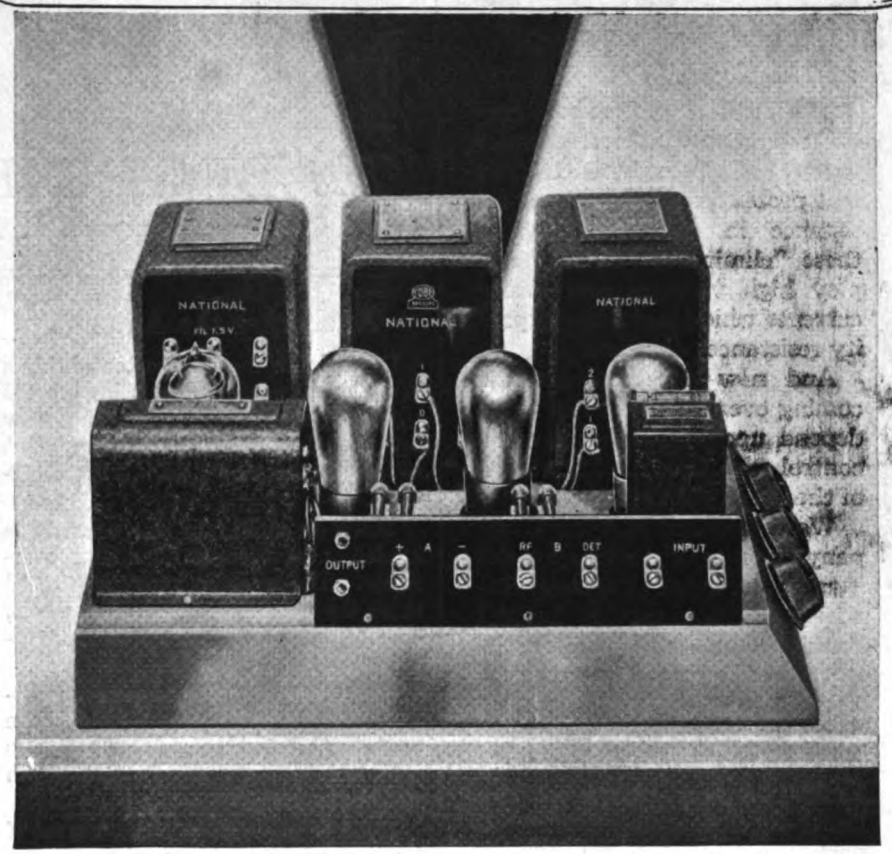
Now, you just wire the studios that you wish to have such and such a song played and it will not only be played, but it will be dedicated to *you*.

According to late reports, this new puller of boob wires is working out beautifully in the West, where announcers are announcers and most of the radio is terrible. Is there any wonder that Western Union showed such a good report for the third quarter?

A ONE-METER TRANSMITTER

One of the features of the Radio World's Fair in New York was this unique exhibit that operates on AC current. Two square discs act as the fixed condenser; a small radio tube is enclosed in the metal shield.

NATIONAL
POWER AMPLIFIER



MAKES your present Radio Set the last word in Fidelity of Reproduction,—and supplies all B and C current from the lamp socket.

Designed on sound engineering principles in collaboration with Arthur H. Lynch and James Millen, it combines B-power-supply and complete audio-amplifier of the highest type. It is made to use either the Raytheon BH or Rectron Rectifying Tube. Each unit is newly designed for heavy and continuous duty, built to established NATIONAL standards.

The NATIONAL POWER AMPLIFER is designed to plug directly into the detector output of any Radio set and has one stage of NATIONAL Impedaformer and two stages of resistance coupling with Lynch Resistors. Output from the UX-171 semi-power tube is through a NATIONAL Tone Filter, protecting the loud speaker and still further improving quality. All of the parts mount on a drilled and cored metal base.

Sold in complete kit form, including Raytheon BH Tube and every accessory and piece of wire required (except audio tubes). Easily assembled in an evening.

PRICE $85.00

Price of kit as above but completely assembled ready to run $95.00

The units are also sold separately

For home and professional set builders—for dealers' custom trade.

The NATIONAL POWER AMPLIFIER

NATIONAL products are built to engineering standards of excellence. Anyone who has ever built a set using NATIONAL BROWNING-DRAKE Coils and Transformers knows what that means. Send for Bulletin 116-PR.

National Co. Inc., Engineers and Manufacturers,—W. A. Ready, Pres., Cambridge, Mass.

Makers of NATIONAL BROWNING-DRAKE Coils and R. F. Transformers, Impedaformers, Condensers, Power Transformers, etc. for Radio.

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How to use
Resistance
in Radio!

Send
for this new booklet!

POWER amplifiers and current supply units, so popular today, have brought with them real problems on the use of resistance in radio. Many of these "eliminator" circuits employ high voltages and heavy currents which make low capacity resistances obsolete.

And new developments are coming every day! All of them depend upon resistance for the control of current—knowledge of the subject is important.

Ward Leonard Electric Company, for more than 35 years the manufacturer of Vitrohm Resistors, announces a helpful booklet which covers this problem of resistance and its use. It is of interest to experimenters, engineers, and merchants.

"How To Use Resistance in Radio" covers many of the latest developments in radio. A partial list of the subjects is given below.

- *High-Voltage Current-Supply Unit*
- *Variable Charging Rate Trickle Charger*
- *110-Volt Direct Current, A & B Supply Unit*
- *32-Volt Direct Current, A Supply Unit*
- *Power Amplifier and Plate Supply Unit*
- *How to obtain Grid Bias Voltages (C Battery) from your present eliminator)*
- *Alternating Current Operated Receiver*

7235-4
Ward Leonard Electric Company
37-41 South St., Mt. Vernon, N. Y.
I am enclosing 15 cents for my copy of *"How to Use Resistance in Radio"*
Name.....
Address.....
City.....
State.....

Ward Leonard Electric Company

A catalogue of Ward Leonard Vitrohm Resistors for radio will be sent free, upon request.

The BEGINNER IN RADIO

CONDUCTED BY ARMSTRONG PERRY

Anchoring the Antenna

ONE of the most important bridges in the country came near being erected without strength to sustain the snow load—all because an engineer forgot to include the snow load in his calculations.

Many an aerial fails just when it is needed most because of similar oversights. The snow load may be several times the weight of the wire when soft, clinging snow falls just before the thermometer goes to freezing.

Antenna masts often have an unsightly bend at the tip because flagstaffs have been used instead of more rigid poles that can take the weight and strain without bending.

There is no need to erect a mast if there is a tree that can be used. An antenna that is anchored in a tree or that passes through one should be made of weather-proof wire, and that costs more than bare wire and does not last as long, but the extra expense for wire is much less, usually, than the cost of erecting a mast as high as the tree.

Trees are valuable and their welfare should be considered as carefully as the success of the aerial. A band or wire around a limb will restrict its growth and may kill it. Tree surgeons recommend lag screws or eyebolts. Eyebolts are more secure because the washers and nuts prevent them from pulling out, but it may be more convenient to screw in a lag than to bore a hole for a bolt. A galvanized screw or bolt three-eighths or one-half inch in diameter and long enough to pass through the limb is strong enough for ordinary conditions. The limb used should be at least three times the diameter of the metal and be perfectly sound.

A pulley should be fastened to the eye before the screw or bolt is attached to the tree. This is done by spreading

HOW TO ANCHOR THE ANTENNA TO THE ROOF

The wooden brackets and large glass insulators used on power lines make a good anchorage for the house end of the antenna for they are both strong and cheap and they are easy to attach.

30 DAYS FREE TRIAL

7 Tube Set *Single Dial Radio*

The Metrodyne

ONLY ONE DIAL TO TUNE

Retail Price

$75

Completely Assembled

Big Discounts to Agents and Dealers

Wonderful offer direct from the factory! The world's greatest radio.

A perfect working, single dial control, 7 tube receiver. And just to prove our claims, we will ship it to your home for **30 days' free trial.** Test it under all conditions. Test it for distance, volume and tonal quality — and if you are not convinced that it is the best single dial set you ever heard, return it to the factory. We don't want your money unless you are completely satisfied.

BIG PROFITS TO AGENTS AND DEALERS

Our Agents and Dealers make big money selling Metrodyne Sets. You can work all or part time. Demonstrate the superiority of Metrodynes right in your home. Metrodyne Radios have no competition. Lowest wholesale prices. Demonstrating set on 30 days' free trial. Greatest money-making opportunity. Send coupon below—or a letter—for our agent's proposition.

Metrodyne Super-Seven Radio

A single dial control, 7 tube, tuned radio frequency set. Approved by America's leading radio engineers. Designed and built by radio experts. Only the highest quality low loss parts are used. Magnificent, two-tone walnut cabinet. Artistically gilded genuine Bakelite panel, nickeled piano hinge and cover support. All exposed metal parts are beautifully finished in 24-k gold.

Easiest set to operate. Only one small knob tunes in all stations. The dial is electrically lighted so that you can log stations in the dark. The volume control regulates the reception from a faint whisper to thunderous volume, 1,000 to 3,000 miles on loud speaker! The Metrodyne Super-Seven is a beautiful and efficient receiver, and we are so sure that you will be delighted with it, that we make this liberal **30 days' free trial offer.** You to be the judge.

30 Days' FREE Trial

6 Tube Set $48.50 RETAIL PRICE *Completely Assembled*

Metrodyne Super-Six

Another triumph in radio. Here's the new 1927 model Metrodyne 6 tube long distance tuned radio frequency receiving set. Approved by leading radio engineers of America. Highest grade low loss parts, completely assembled in a beautiful walnut cabinet. Easy to operate. Dials easily logged. Tune in your favorite station instantly on same dial readings every time. No guessing.

Mr. Howard, of Chicago, said: "While five Chicago broadcasting stations were on the air I tuned in seventeen out-of-town stations, including New York and San Francisco, on my loud speaker horn, very loud and clear, as though they were all in Chicago."

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal **30 days' free trial offer,** which gives you the opportunity of trying before buying.

MAIL THIS COUPON

or send a postal or letter. Get our proposition before buying a radio. Deal direct with manufacturer— **Save Money.**

Mail COUPON Below!

Let us send you proof of Metrodyne quality

F. L. Warnock, Greentown, Ind., writes: "I received the Metrodyne in good shape and am more than pleased with it. Got stations 2,000 miles away."

C. J. Walker, Mariposa, Calif., writes: "Received my Metrodyne Single Dial set O. K. I believe that these one-dial sets are going to be excellent sellers. I had no trouble in tuning in stations enough to satisfy anyone, so you will please send me another set."

Roy Bloch, San Francisco, Calif., writes: "Very often we travel from New York to the Hawaiian Islands quickly — from station to station — by means of the little tuning-knob which operates the electrically-lighted dial. The Metrodyne Single Dial Set is much easier to operate than any radio set I've ever seen."

We will send you hundreds of similar letters from owners who acclaim the Metrodyne as the greatest radio set in the world. A postal, letter or the coupon brings complete information, testimonials, wholesale prices, and our liberal **30 days' free trial offer.**

METRO ELECTRIC COMPANY
2161-71 N. California Ave., Dept. 131
Chicago, Illinois

Gentlemen:

Send me full particulars about Metrodyne 6 tube and 7 tube sets and your **30 days' free trial offer**

*Name*_____

*Address*_____

If you are interested in AGENT'S proposition, place an "X" in the square ☐

METRO ELECTRIC COMPANY

2161-71 N. California Ave. • Dept. 131 • Chicago, Illinois

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FULL SIZE BLUE PRINTS

Price $1.00 Per Set

LAURENCE M. COCKADAY has personally supervised the preparation of *Simplified Blueprints* of thirteen of POPULAR RADIO'S most popular circuits. Each set consists of one or more *Actual Size* Blueprints: first a Panel Pattern; second, an Instrument Layout; and third, a Picture Wiring Diagram all simplified in the fullest sense of the word because

The Panel Pattern can be laid on the panel and all holes drilled as indicated. No scaling to do and so accurate there is no danger of ruining the panel through faulty calculation.

The Instrument Layout placed on the sub-base permits you to indicate by pinpricks the exact location of every screw.

The Picture Wiring Diagram gives every instrument in exact size, and position with every wire clearly indicated from one contact to the other. With no knowledge of radio symbols you can assemble every part and complete your wiring with no chance of error.

Set No. 4—"*Cockaday 4-Circuit Tuner with Resistance-Coupled Amplifier*" (five tubes, distortionless, two dials, automatic vacuum tube control, as described in the October 1924 issue of POPULAR RADIO).

Set No. 6—"*The Cockaday 8-Tube Superheterodyne Reflex Receiver*" (eight tubes, two tuning dials, loop, non-radiating, distortionless, as described in January 1925 issue of POPULAR RADIO).

Set No. 12—"*8-Tube Super-heterodyne with Single Control*" (as described in October 1925 issue of POPULAR RADIO).

Set No. 14—"*The LC-86 Broadcast Receiver*" (as described in December 1925 issue of POPULAR RADIO).

Set No. 16—"*The S-C All-Wave Receiver*" (as described in the March 1926 issue of POPULAR RADIO).

Set No. 17—"*The Power-pack Amplifier*" (as described in the April 1926 issue of POPULAR RADIO).

Set No. 18—"*The Improved Raytheon Power-Pack*" (as described in the May, 1926, issue of POPULAR RADIO).

Set No. 19—"*The New Home Receiver*" (three tubes, two stages of radio-frequency-amplification with crystal detector, as described in June, 1926 issue of POPULAR RADIO).

Set No. 21—"*The Improved Browning-Drake Receiver*" (as described in the August, 1926, issue of POPULAR RADIO).

Set No. 22—"*The LC-27 Broadcast Receiver*" (as described in the October, 1926, issue of POPULAR RADIO.)

Set No. 23—"*The LC-Senior Power-Pack*" (as described in the November, 1926 issue of POPULAR RADIO)

Set No. 24—"*The LC-Intermediate Power-Pack*" (as described in the December, 1926 issue of POPULAR RADIO.)

Set No. 25—"*The LC-Junior Power Pack*" (as described in the January 1927 issue of Popular Radio).

Full constructional and parts details for these Receiving Sets will be found in the issue of POPULAR RADIO indicated.

Back issues of POPULAR RADIO will be furnished at the rate of 35c a copy.

POPULAR RADIO

Department 14

627 West 43d Street, New York

POPULAR RADIO, Inc., Dept. 14.
627 West 43d St., New York City

Date.....

Enclosed is my remittance of $..... for which kindly send me Blueprint Set (s) consisting of Panel Pattern, Instrument Layout and Wiring Diagram as checked below:

☐ Set Number 4 ☐ Set Number 18
☐ Set Number 6 ☐ Set Number 19
☐ Set Number 12 ☐ Set Number 20
☐ Set Number 14 ☐ Set Number 22
☐ Set Number 16 ☐ Set Number 23
☐ Set Number 17 ☐ Set Number 24
☐ Set Number 25

Name.....

Address.....

City..... State.....

the ring of the pulley, or the eye, and linking them together. After they are linked, they should be inspected carefully to discover if any cracks have started; some stock is so poor that it is weakened by spreading and breaks when the strain is placed upon it.

The pulley should be large enough to give the halyard plenty of room after exposure to the weather swells it. Sash cord is strong enough for any but very long aerials or those made of very heavy wire. It should be straightened and all tendency to kinking should be eliminated before it is rove through the pulley. An extra length of the cord should be kept on hand. As soon as the halyard shows the first sign of weakening, the end of the new cord should be sewn smoothly to the end of the old and pulled through the pulley; otherwise, someone may be tempted to climb the tree under dangerous conditions.

The two ends of the halyard should be tied together. When they are untied for any purpose, the cord first should be anchored so that it cannot escape. Even when the ends are joined they cannot be permitted to whip about without danger of the rope getting beyond reach. A bucket of sand or stones, with the weight adjusted to hold the aerial taut with the minimum strain on the limb and halyard, is the best anchor; it adjusts itself automatically to the movements of the tree and maintains an even strain. This arrangement makes it easy to lower the aerial for inspection and changes, and is ideal for experimenters. If children use the bucket for a swing, make it a hanging garden filled with plenty of thistles and pincushion cacti!

RAISING THE ANTENNA

When the antenna has been raised to the proper height by means of the halyard, a bucket of sand or stones should be attached to the end of this rope as an anchor.

The achorage at the other end of the aerial also is important. The wooden brackets and glass insulators used on light and power lines are strong and cheap. To insure strength, the best method is to wrap two or three turns of the aerial wire around the insulator, but as such turns produce both inductance and capacity it may be better to tie the wire to the insulator with plenty of friction tape or other strong, non-conductive material. When very short waves are to be received there should be no turns in the aerial wire around the insulator.

With the aerial firmly anchored at both ends, the lead-in can be installed and changed at will without disturbing the higher wires that are so much harder to reach.

* *

This radio fan, Carl Laemmle, Jr., sent a $2,500 radiogram to get a scenario to a film company on time.

$2,500 to Send a Single Radiogram

CARL LAEMMLE, JR., age eighteen, is a radio fan. He turned to radio recently to help him to get out of a tight place.

He was writing a series of ten scenarios, entitled "The Collegians," for which he was to receive $1,000 each. While touring Europe with his father, in search of material for the photoplay, his father became dangerously ill. Young Laemmle was too anxious about his father to think of his work for some time. When the crisis was passed and the patient well on the way to recovery, the boy realized suddenly that one of his scenarios would be due in Hollywood within a few days and that there was not time enough to send it by mail even if it were ready.

He finished the scenario as quickly as possible and sent it from London to Hollywood by radio. The bill was $2,500—but the scenario reached the producing company on time.

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One Dial LONG DISTANCE 5 TUBE RADIO $25.00

EVERYBODY, including experienced radio engineers said — it cannot be done. But we did it—produced a high grade, long distance single dial control radio to operate a loud speaker to retail for $25.00—and yet allow liberal discount to agents.

This marvelous instrument is the result of five years hard work by an organization of trained radio engineers. It is no experiment —thousands are in use—the results speak for themselves.

There Will Be a Radio In Every Home

Thousands have been waiting for just such a radio —a real long distance, powerful instrument but—at a price they can afford.

It is here, and live wide awake salesmen will recognize their opportunity immediately—they won't lose a single minute writing for full information.

Just as there are 100 Fords to one high priced car, just so will there be 100 Vikings to every $75.00 and $100.00 radio—think what this means to men who get in on the ground floor right now.

A $25 Radio That Gives You a $75 Value

Put a Model 599 Viking which retails for $25.00 alongside any radio retailing for $75.00 and even more. Compare them for ease of tuning—only one dial to tune on the Viking—distance received, volume and tone. The results will make any man say, "I'll save that $50.00."

Radio is today the biggest and quickest selling line—thousands are being sold—salesmen have made unheard of profits. But here is a far greater, a far more interesting radio proposition than anyone ever dreamed of.

You Should Make $100.00 a Week Easily

You can't help it—many will make more. Some will control a county—others will control many counties. We have the livliest radio selling plan of today—instruments of all prices—a radio price to fit every pocketbook.

Any man who will follow our teaching cannot help but add big money to his present income and start to do it immediately. If you want more money here is your chance but you'll have to act quick—others will jump at this chance.

Agents Wanted Make $100.00 a Week

Sell Radio in Your Spare Time—Evenings

You don't even have to give up your present position. The only time radio can be sold is in the evening—by demonstration. So here is a chance to add to your present income. During the past five years we have trained 4364 men in this very profitable business.

You'll be the first one with a real low priced long distance radio—your price will startle everybody—the results will be even far more startling. Once you demonstrate you're sure of a sale. No one can think of investing $75.00 to $100.00 in a radio when this instrument will get the same results and your retail price is only $25.00. Just think of the advantage you have. Sell a radio for only $25.00, and yet make a handsome commission.

A Regular Radio at a Price Unheard Of

Uses five No. 199 tubes, operates on three ordinary dry cells. Only one dial to tune—a feature generally only found in the highest priced instruments. Any child can tune the Model 599 VIKING—simply turn the dial. Cabinet is extremely attractive, 12 inches long, 8 inches high and 6 inches deep. The wood is covered with Keratol, embossed in a very attractive design. On the front are two very odd gold colored, colonial designs inserted in two panels. The base and ends are finished in a rough gold and black colored finish which together with the rich seal brown Keratol of the balance makes a cabinet that would be an ornament in any home.

The tuning is arranged so that it is accomplished by the use of one special low loss condenser and a basket weave coil. Sockets, rheostat, potentiometer and base board are all of bakelite. Three transformers give an abundance of volume for loud speaker. Parts will equal the average $75.00 or $100.00 radio instrument—only enormous production could possibly bring about this low price.

Territory is Going Fast—Better Write Today

Someone is going to get the big profit on the sales of these instruments in your community —is that someone going to be you? Write today for our 100 page book which fully describes not only this wonderful instrument but also a full line of radio at all prices. It's FREE for the asking.

Use This Coupon

H. D. Fischer,
120 W. Austin Ave.; D
Chicago, Illinois.

I am interested in selling your 5 tube set in this territory. Please send me your 100 page radio book, FREE.

Name.....

Address.....

City..... State.....

SEND FOR 100 PAGE FREE BOOK

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Make Your Own
CONE SPEAKER
MONSTER SIZE
CIRCULAR CUT 3 FOOT HIGH READY TO GLUE
FREE
Instructions and Blue Print
Do you know that clarity of low tones and notes are obtainable only in speakers of at least this size? Build this FENCO CONE and note the difference.
Direct to Consumer
So easy to assemble that a child 12 years old can put it together in 30 minutes.
Send P. O. Money Order or Check
Only $12. Complete
Equal to $60 manufactured speaker, 30 minutes easy work saves you $48
HERE'S WHAT YOU GET
2 Sheets (circular cut) Alhambra Fen-o-tex paper
FENCO special adjustable balanced Unit
1 Baffle ring and set of Apex fittings
1 Mounting bracket and iron handle
1 Can Ambroid cement
3½ yds. Oriental gold lace
All for ONLY $12 postpaid
FEN-CO CONE CO., 67 Murray St., New York

Simplified Blue Prints
of the
"Town and Country"
Portable Receiver

The "Town and Country" Portable Receiver, developed by the POPULAR RADIO LABORATORY and described in July, 1926 issue, marks a decided advance in portable receiver design. While not a "vest pocket" receiver, the new "Town and Country" is small enough to be taken along on a motor boat or train trip. Efficiency has not been sacrificed for the sake of compactness.

The receiver uses six UX-199 tubes and one UX-120 power tube. Operating on a loop, tone quality is guaranteed by the use of a fundamentally correct circuit, high-class transformers and cone-type speaker.

The new "Town and Country" Portable Receiver is mounted in a special mahogany cabinet with a drop front and is equipped with a carrying handle. All equipment, including the folding loop, cone loud-speaker, batteries and connecting cable, is installed in a suitcase. Connections from the equipment to the set are made by means of jacks and plugs.

By using POPULAR RADIO Blue Prints in building your "Town and Country" receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory models (see page 104).

If your local dealer cannot supply you with Blue Prints of this set, they will be sent postpaid upon receipt of $1.00 per set.

POPULAR RADIO
Service Bureau 14-B
627 W. 43rd St., New York City

BROADCASTS

CONDUCTED BY CHARLES L. REESE, JR.

Radio Pays the Penalty of Congressional Indifference

RADIO conditions in the Middle West are reported as becoming more and more chaotic as a result of the "hands off" policy of the Federal Government. It is said that five stations in the district that have changed their wavelengths now interfere with reception from 23 other broadcasters and a petition has been sent from one of the principle cities of Tennessee signed by 70 listeners in asking the government for relief.

* *

Australia Demands Broadcast Service

THE long-suffering American fan who spends half of his time at the radio in trying to find a point on the dial where no more than one station comes in at a time will find the demands that his Australian cousin makes of his broadcasting stations a little more than Utopian. The particular Australians demand that their stations broadcast on wavelengths at least 50 meters apart so that even the least selective set will have no trouble in separating them and in addition they ask that the broadcasters transmit on long waves at night and on short waves in the daytime hours in the hope that this will improve reception.

* *

A "Secret" Radio for Mussolini

A RADIO transmitter which, it is claimed, will transmit messages that cannot be read except by those for whom they are intended and which is free from interference from other stations was recently presented to Mussolini by John Hays Hammond, Jr., the American inventor. The system employed by Mr. Hammond in what he calls his "narrowcasting" radio is the transmission of a low-frequency carrier wave modulated with super-audible waves. The inventor claims that no one who does not know the frequency of both the carrier wave and the modulating wave can listen in on the transmissions.

The Coming of the "Radio Reporter"

RADIO announcers are achieving a new dignity now that the radio stories of big news events are being printed verbatim in the newspapers. The first event of this kind was the Dempsey-Tunney fight, when three expert stenographers, working in relays, were employed to take down the announcements of J. Andrew White and Graham McNamee as they came over the radio.

* *

China Opens Door to Radio

THE latest sign that the charms of radio are at last conquering the age-old prejudice of the Far East against anything new is the news that the bars against radio are down in Southern Manchuria. Up to now the use of radio receiving sets in this part of China has been prohibited to the ordinary person, but now a broadcasting station is to be built at Mukden and anyone who is willing to pay the tax of 25 cents on crystal sets and 50 cents on tube sets may own a receiver and listen to the programs broadcast.

* *

Map-making by Radio

RADIO is proving to be of tremendous value to the map-maker, especially in the world-wide longitude determinations that are now under way, according to a statement recently made by Dr. William Bowie of the Coast and Geodetic Survey. When wired lines had to be used, survey stations could only be set up at a limited number of points but now, with the aid of radio, longitude stations may be set up in comparatively inaccessible locations to compile and to transmit data on the experiments.

* *

Amateurs Keep in Touch with "River of Doubt" Expedition

THE Roosevelt "River of Doubt" Expedition, which has by now penetrated far into the wilds of Brazil, has been able to keep in constant touch with civilization through the efforts of amateurs in the United States. The radio apparatus used by the expedition was also built by New York amateurs.

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30 DAYS FREE IN YOUR HOME

Tested and approved by all of Radio's Highest Authorities

Send Coupon for Amazing Special Offer!

Unless Trial Proves Your Miraco The Most Selective, Clearest Toned and Most Powerful Distance Getter Among Sets up to 8 Tubes, Don't Buy It!

SPECIAL WHOLESALE PRICES to User-Agents who will allow friends to listen to their Miracos.

BEAUTIFUL-BIG-POWERFUL Ultra Selective MIRACO Ultra 5

Retail LIST Price $~~75~~ now only 40

GET SPECIAL OFFER

One year GUARANTEE

Built like—to look like—and perform like $200 sets

Real Single Dial Control!

Magnificent Big Powerful Miraco "Unitune-5" Get Special Offer and Amazing Low Price!

The celebrated Miraco Ultra-5—U.S. Navy type circuit, has also been adapted to Single Dial Tuning—**without sacrifice of selectivity, volume, clearness, power, tone, or distance getting qualities!** In the magnificent big Miraco Unitune-5, above shown, you turn one vernier knob for stations everywhere. Beautiful hand-rubbed, piano hinged, solid walnut cabinet, 28 in. long, 15 in. deep, 10 in. high. Sloping Bakelite panel is walnut finished to match. **Also offered on 30 days free trial!**

Coast to Coast and Foreign Reception Certified by Miraco users

MIRACO RADIO GETS 'EM COAST to COAST

Send for Proof!

Notice! Enormous sales of the celebrated Miraco big fine Receivers (resulting from delighted users so highly endorsing them to friends) again enable us to add hosts of costly new features, latest refinements and up-to-the-minute improvements such as you might expect to find only on much higher priced sets. Miraco's this year are still better—more beautiful—more selective—more powerful for less money than ever before.

USER-AGENTS WANTED - - WRITE!

Reports from users everywhere leave little for us to add. These are only a few of the many in our files and which we receive daily. Send coupon for plenty of additional proof and testimony of nearby users.

HAS NO EQUAL FOR TONE, VOLUME, DISTANCE. North Wildwood, N.J. Miraco best packed set I ever saw shipped. Words cannot express the wonderful tone quality volume, and distance. First night received 47 stations on Loudspeaker. Up to last night, the 5th day, I have received exactly 103 stations; farthest is KGO, Oakland, Calif. on loudspeaker. Also Porto Rico, Cuba and Canada. Francis B. Lee.

TONE QUALITY PLEASES EVERYONE. Philadelphia, Pa. Everyone that hears the Miraco is very pleased with tone, distance, etc. I tuned in during International Test Week; KGO, Oakland, Calif.; CYB, Mexico City, Mex.; 6KW, Cuba; 2EH, Edinburgh, Scot.; also a station in Buenos Aires, Argentine. Geo. W. Hill, Jr.

WISCONSIN HEARS COAST TO COAST. Racine, Wisc. I got station 2LO London last Wednesday night on my Miraco. Heard a choir sing and announcement. Have also heard PWX, Havana, Cuba; CYZ, Mexico City and 104 American stations from coast to coast. Lawrence Risberg.

SELECTIVITY!--CUTS THROUGH STRONG LOCALS. Detroit, Mich. I am more than satisfied with my Miraco. I can cut through WWJ, WCX, WJR, WGHP, very strong local stations, and this is done with quarter of a turn. In every way it is simply perfect. Charles Paul.

UTAH ENJOYS COAST TO COAST PROGRAMS. Heber City, Utah. The Miraco sure can't be beat at any price. Coast to coast it sure does reel more. I have had stations in New York and Cuba in the east, and scores of other stations on the west coast. I have logged up to date 150 stations and they all come in wonderfully. Monte Giles.

MIRACO WINS AGAINST 3 OTHER MAKES. Pearland, Texas. I tried three other makes and the Miraco is the best of them all. Received KFI, Los Angeles, Calif. on loudspeaker, O. H. Richards.

Nacogdoches, Texas. On my Miraco I have heard stations from Cuba to San Francisco and from Mexico City to Pittsburgh. Walter M. Frisbie.

COAST TO COAST LOUD AND CLEAR. Guthrie, Minn. We logged over 30 stations and got over 1500 miles on the loud speaker the first night--our first experience tuning a radio. The third night we got WJAX Jacksonville, Florida and KFI Los Angeles, Calif., on the loudspeaker. Neighbors say Miraco is the best they have ever heard. O. R. Wolf.

MIRACO BEATS A SUPER EIGHT. Cobalt, Ontario, Canada. Miraco is one of the best radios in all the north country. There is a man here who has a big Super eight and our Miraco beat it. W. Saumier.

OUTPERFORMS SOME $300 SETS. Blakely, Ga. I am well pleased with my Miraco. It does better than machines that cost $300 or more. J. D. Tison.

MOST SELECTIVE--SUPERIOR TO $120.00 SET. Santa Cruz, California. I do not hesitate to show my friends the "Miraco Superiority" over my (names another set) costing $120.00. The Miraco is the most selective set I have seen yet and cuts out the jumble of stations on the low wave lengths in 1 1/2 points. Wm. Schuette.

MELLOW TONE -- LOUD AND CLEAR. Indian River City, Fla. A wonder set. Am having splendid results. Have had Miraco four nights and have stations on my list from Cuba to New York, Chicago, Denver, Texas, all coming in loud, mellow in tone and clear. I have one sold already and did not even try. Mr. H. G. Duff.

REFUSED TO TRADE IT FOR EXPENSIVE SET. Prosper, Ore., over 31 stations brought in first night on loud speaker. I ordered the Miraco for a friend and he is more than pleased. I offered to trade my Neutrodyne for it but he refused and it has the name of the best set in the community. M. E. Hulton.

PENNSYLVANIA BEGINNER GETS 'EM ALL OVER. Corry, Pa. Have had Miraco one month today and have received over 115 stations from all parts of the United States, Canada, Cuba and Mexico. I think this is pretty good for one that never had any experience before. Clarence Drugfelder.

LIKES IT BETTER THAN $150 --$250 SETS. Westville, Ill. Miraco sure is a wonderful set. I get the stations easily without noise--that's one of the things I like about the Miraco. I've had three other sets that have ranged from $150 to $250 each but Miraco beats them all. My friends all like the Miraco. I have had stations all over the U.S.A. I tune in Mexico City and Havana, Cuba any time they are on the air. Alex Kinder.

BEATS COSTLIER SETS WITH MORE TUBES. Lexington, O. I have given Miraco a thorough try out and find it to do all you claim. 85 stations logged so far; getting new ones every week. This list includes coast to coast, Canadian, Cuban and Mexican stations. The **selectivity is remarkable.** Others here in town have more expensive and elaborate sets with more tubes but do not ever do this. Fuller Temple.

MIRACO OUTPERFORMS THEM ALL. St. Francis, Kansas. I've heard a lot of radios but the Miraco is best all around. I am proud of mine. Comes in fine and clear. No noise. Get lots of distant stations. Surely am satisfied. Orvey Sharpe.

Big Powerful New MIRACO Ultra 5

Solid Walnut Cabinet — Unitune 5 — 28 in. long

Solid Walnut Cabinet — 27 in. long

TRADE MARK REGISTERED

ULTRA-SELECTIVE LONG DISTANCE 5 TUBE SETS EASY ON BATTERIES

Why run down your costly batteries burning 6, 7 or 8 tubes when users everywhere report that powerful big Miraco sets actually are *unsurpassed* (even at 2 to 4 times the price) for razor-edge selectivity, extreme long distance reception, clear natural tone, quiet easy tuning and powerful loud speaker volume—*combined with great savings in use of battery current.*

Be Convinced—at Our Risk!

Enjoy a big powerful Miraco 30 days in your home. Compare it with highest priced sets. Then decide. Your verdict final. Remember, this offer is made *direct to you* by a famous big Radio Corporation—one of America's oldest, reliable makers of fine sets. Many thousands of satisfied customers. Postal or coupon brings testimony of nearby users and plenty of proof.

Factory Prices Save You Up to ½!

Save or make a lot of money on sets, speakers, tubes, batteries, etc., by getting our *Amazing Special Offer.* Wonderful bargains! *Everything we sell is high-grade.* Don't confuse Miraco's with small cheap radios. Satisfaction unconditionally guaranteed.

RELIABILITY!

The Midwest organization was one of the very first to engage in the manufacture of radio sets. We consider them to be both morally and financially responsible. They have a reputation for fair and square dealings.—THE PROVIDENT SAVINGS BANK & TRUST CO.

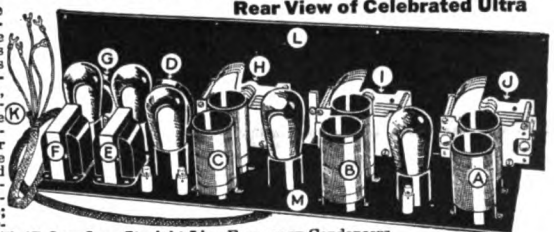
You'll Be Proud of a Miraco!

Yes, you'll be proud to have friends see and hear your Miraco in its big, handsome, expensive-looking solid walnut cabinet with sloping front. In construction and performance too, every inch a high priced set. Handsomely gold illustrated genuine Bakelite front panel finished in grained walnut. Finest parts obtainable—the kind used in $200 sets. *Many exclusive features.* Each Miraco reaches you completely assembled, rigidly tested, splendidly packed and factory guaranteed for one year. Easy to install and operate—full instructions supplied. Send now for testimony of nearby users and *Amazing Offer!*

Compare the construction with highest priced sets—study this picture

Note the neat sturdy high-class construction; wide spacings between parts eliminate losses and interference. All wiring concealed under genuine Bakelite base panel (M). Flexible wiring prevents broken or noisy connections. Flush-type sockets for the new tubes. (A) (B) (C)—"Duoformers"—famous exclusive Miraco Ultra low loss, self shielded and matched coils—one of the Miraco secrets of selectivity with powerful volume on long distance stations. (D) "Counter Balancer"—patented feature, NOT a rheostat or potentiometer. Controls oscillations on all wave lengths, reduces "B" battery consumption and further increases selectivity, distance range, clarity, power and volume. (E) (F) Shielded transformers of famous make evenly amplify all notes; beautiful tone quality. (G) Tone Modulator—regulates volume, switches current off or on. (H) (I) (J) Low Loss Straight Line Frequency Condensers —highest grade—equipped with ball bearings. Solid brass plates. Evenly separate all stations. (K) Connect E-Z Cable for attaching batteries. (L) Genuine Bakelite front panel. And many other latest features of costliest sets. Literature describes them fully, send for it!

Rear View of Celebrated Ultra



AGENTS! DEALERS! Write for proposition. Nation-wide popularity, superior performance, amazingly low prices, make Miracos easy to sell.

All the Proof you want is waiting for You!

Coupon or postal brings reports from hosts of users in your vicinity and elsewhere proving that Miraco sets **at rock-bottom money-saving factory prices,** outperform sets costing up to four times as much. **You can also buy speakers, tubes, batteries, etc., at big savings from us!** Get our proposition before spending money elsewhere.

Send coupon for Amazing Special Offer!

MIDWEST RADIO CORPORATION
Pioneer Builders of Sets
Cincinnati, O.

479-S Miraco Building

Without obligation, send free literature, testimony of users, AMAZING SPECIAL OFFER and full particulars of your **big money-saving factory-price proposition** on Guaranteed Miraco sets and all radio supplies. ( ) Agent ( ) User ( ) Dealer

NAME

ADDRESS

This Coupon Is NOT An Order

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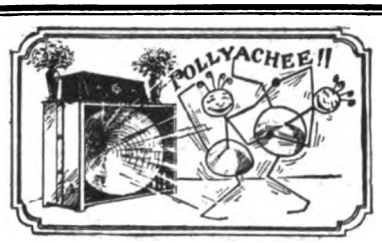

With the "Ensco 3 ft. Cone Kit" you can make your own Cone Speaker in less than an hour—You can then enjoy all of the True Tones of Music without distortion.

Complete parts furnished in kit form. We guarantee this speaker the equal of any manufactured cone speaker at any price.
With this THREE FOOT CONE SPEAKER you hear *all* the tones. It brings out the true depth and beauty of orchestral and instrumental music. Can be operated softly for living room music or full volume for dancing, and without trace of distortion.
Kit includes famous "ENSCO" cone unit, the only direct drive, distortionless unit for large cones; Alhambra Fonotex for big cone, with brass apex, two Sepia Prints showing cabinet or simple stand construction. All necessary instructions.
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The Improved Browning-Drake Broadcast Receiver, designed by Arthur H. Lynch, former Editor of Radio Broadcast and built and approved in the POPULAR RADIO LABORATORY.

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By using POPULAR RADIO Blue Prints in building your Improved Browning-Drake Broadcast Receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory model (see page 104).

If your local dealer cannot supply you with Blue Prints of the Improved Browning-Drake, they will be sent postpaid upon receipt of $1.00 per set.

A full description of this set, with detailed directions for building, was published in the August, 1926, issue of POPULAR RADIO. Send 35c for copy.

POPULAR RADIO

Service Bureau 14-A

627 W. 43rd St., New York City

Outstanding Program Features of the Month

DECEMBER 20th TO JANUARY 15th

DURING the coming month, December 20th to January 15th, the following regular and special program features are scheduled. This list, which will be augmented monthly as advance information is received, will be published in each issue of the magazine; all broadcast stations are invited to report coming program features of outstanding interest or importance. Reports should reach the Editor of POPULAR RADIO on or before the 23rd of the month preceding.

DECEMBER
(Eastern Standard Time)

20th; *Willys-Overland Hour*, WJZ; 8:30 P.M.
20th; *A & P Gypsies*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ).
20th; *Fireside Boys* (vocal), WJZ; 9:50 P.M.
20th; *B. A. Rolfe's Palais D'Or Orchestra*, WEAF; 11:00 to 12:00 M.
21st; *Champion Spark Pluggers*, WJZ; 8:00 P.M. (Also broadcast from WGY and WRC).
21st; *Vikings*, WEAF; 8:00 to 8:30 P.M. (Also broadcast from WEEI, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC).
21st; *Jolly Buckeye Bakers*, WEAF; 8:30 to 9:00 P.M. (Also broadcast from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG and WLIB).
21st; *Eveready Hour*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI and WTAG).
21st; *Keystoners*, WJZ; 9:00 P.M. (Also broadcast from WRC and WGY).
21st; *Auction Bridge Instructions*, WEAF; 10:00 P.M. (Also broadcast from WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO, and KSD).
21st; *Cook's Tours*, WJZ; 10:00 P.M. (Also broadcast from WRC and WGY).
21st; *George Olsen's Orchestra*, WJZ; 10:45 P.M.
22nd; *Eastman Theatre Orchestra*, WJZ; 6:30 P.M. (Also from WHAM).
22nd; *Davis Saxophone Octette*, WEAF; 8:30 P.M. (Also broadcast from WEEI, WJAR, WLIT, WRC, WTAG and WCAE).
22nd; *Ipana Troubadours*, WEAF; 9:00 to 9:30 P.M. (Also broadcast from WEEI, WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).
22nd; *Sixty White Minutes* (orchestra), WJZ; 9:00 P.M. (Also broadcast from WBZ, KDKA and KYW).
22nd; *Smith Brothers* (vocal and instrumental); WEAF; 10:00 to 10:30 P. M. (Also broadcast from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF).
23rd; *Royal Typewriter Orchestra*, WGY; 9:00 P.M. (Also broadcast from WRC, WBZ and WJZ).
23rd; *Goodrich Zippers* (orchestra and vocal), WEAF; 10:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSI, WWJ, WSAI and WADC).
23rd; *Clicquot Club Eskimos*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ).
24th; *Happiness Boys*, WEAF; 8:00 P.M.
24th; *Breyer Hour* (orchestra and vocal), WJZ and WRC; 9:00 P.M.
24th; *La France Orchestra*, WEAF; 9:30 P.M. (Also broadcast from WEEI, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).
25th; *New York Philharmonic Orchestra with Walter Damrosch*, WEAF; 9:15 P.M. (Also broadcast from WEEI, WGR, WFI, WCAE, WWJ, WSAI, WTAM, WGN, KSD, WCCO and WDAF).
26th; *Capitol Theatre Grand Orchestra*, WEAF; 7:20 P.M. (Also broadcast from KSD, WRC, WWJ, WSAI, WCAE, WTAG).
26th; *Atwater Kent Hour*, WEAF; 9:15 P.M. (Also broadcast from WSAI, WEEI, WFI, WCCO, WTAM, WGN, WFI, WCAE, WGR, WOC, WTAG, WWJ and KSD).
26th; *Godfrey Ludlow* (violinist), WJZ; 9:30 P.M. (Also from WGY).
26th; *Maxwell House Coffee Hour* (orchestra), WJZ; 10:15 to 11:15 P.M. (Also broadcast from WBZ, WRC, WGY and KDKA).
27th; *Willys-Overland Hour*, WJZ; 8:30 P.M.
27th; *A & P Gypsies*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WJAR, WSAI, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ).
27th; *Fireside Boys*, WJZ; 9:50 P.M.
27th; *B. A. Rolfe's Palais D'Or Orchestra*, WEAF; 11:00 to 12:00 M.
28th; *Champion Spark Pluggers*, WJZ; 8:00 P.M. (Also broadcast from WGY and WRC).
28th; *Vikings*, WEAF; 8:00 to 8:30 P.M. (Also broadcast from WEEI, WJAR, WTAG, WGR, WSI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC).
28th; *Buckeye Bakers*, WEAF; 8:30 to 9:00 P.M. (Also broadcast from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG and WLIB).
28th; *Eveready Hour*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI and WTAG).
28th; *Keystoners*, WJZ; 9:00 P.M. (Also broadcast from WRC and WGY).
28th; *Auction Bridge Instructions*, WEAF; 10:00 P.M. (Also broadcast from WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO and KSD).
28th; *Cook's Tours*, WJZ; 10:00 P.M. (Also broadcast from WRC and WGY).
28th; *George Olsen's Orchestra*, WJZ; 10:45 P.M.
29th; *Eastman Theatre Orchestra*, WGY; 6:30 P.M. (Also from WHAM).
29th; *Davis Saxophone Octette*, WEAF; 8:30 P.M. (Also broadcast from WEEI, WJAR, WLIT, WRC, WTAG and WCAE).
29th; *Sixty White Minutes Orchestra*, WJZ; 9:00 P.M. (Also broadcast from WBZ, KDKA and KYW).
29th; *Ipana Troubadours*, WEAF; 9:00 to 9:30 P.M. (Also broadcast from WEEI, WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).
29th; *Smith Brothers* (vocal and instrumental); WEAF; 10.00 to 10:30 P.M. (Also broadcast from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF).
30th; *Royal Typewriter Orchestra*, WGY; 9:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSI, WWJ and WSAI).
30th; *Clicquot Club Eskimos*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ).
30th; *Goodrich Zippers* (orchestra and vocal); WEAF; 10:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSI, WWJ, WSAI and WADC).
31st; *Happiness Boys*, WEAF; 8:00 P.M.
31st; *Hohner Harmony Four*, WEAF; 8:30 to 9:30 P.M. (Also broadcast from WEEI, WLIT, WGR, WRC, WCAE, WLIB, WTAM and WWJ).
31st; *Breyer Hour* (orchestra and vocal), WJZ and WRC; 9:00 P.M.
31st; *La France Orchestra*, WEAF; 9:30 P.M. (Also broadcast from WEEI, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).
1st; *New York Philharmonic Orchestra with Walter Damrosch*, WEAF; 9:15 P.M. (Also broadcast from WEEI, WGR, WFI, WCAE, WWJ, WSAI, WTAM, WGN, KSD, WCCO and WDAF).
2nd; *Capitol Theatre Grand Orchestra*, WEAF; 7:20 P.M. (Also broadcast from KSD, WRC, WWJ, WJAR, WCAE and WTAG).
2nd; *Atwater Kent Hour*, WEAF, 9:15 P.M. (Also broadcast from WJAR, WEEI, WFI, WCCO, WTAM, WGN, WFI, WCAE, WGR, WOC, WTAG, WWJ and KSD).
2nd; *Godfrey Ludlow* (violinist), WJZ; 9:30 P.M. (Also from WGY).
2nd; *Maxwell House Coffee Hour* (orchestra), WJZ; 10:15 to 11:15 P.M. (Also broadcast from WBZ, WRC, WGY and KDKA).
3rd; *Willys-Overland Hour*, WJZ; 8:30 P.M.
3rd; *A & P Gypsies*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ).
3rd; *Fireside Boys*, WJZ; 9:50 P.M.
3rd; *B. A. Rolfe's Palais D'Or Orchestra*, WEAF; 11:00 to 12:00 M.
4th; *Champion Spark Pluggers*, WJZ; 8:00 P.M. (Also broadcast from WGY and WRC).
4th; *Vikings*, WEAF; 8:00 to 8:30 P.M. (Also broadcast from WEEI, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC).
4th; *Buckeye Bakers*, WEAF; 8:30 to 9:30 P.M. (Also broadcast from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG and WLIB).
4th; *Eveready Hour*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI and WTAG).
4th; *Keystoners*, WJZ; 9:00 P.M. (Also broadcast from WRC and WGY).
4th; *Auction Bridge Instructions*, WEAF; 10:00 P.M. (Also broadcast from WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO and KSD).
4th; *Cook's Tours*, WJZ; 10:00 P.M. (Also broadcast from WRC and WGY).
4th; *George Olsen's Orchestra*, WJZ; 10:45 P.M.
5th; *Eastman Theatre Orchestra*, WGY; 6:30 P.M. (Also from WHAM).
5th; *Davis Saxophone Octette*, WEAF; 8:30 P.M. (Also broadcast from WEEI, WJAR, WLIT, WRC, WTAG and WCAE).
5th; *Sixty White Minutes Orchestra*, WJZ; 9:00 P.M. (Also broadcast from WBZ, KDKA and KYW).
5th; *Ipana Troubadours*, WEAF; 9:00 to 9:30 P.M. (Also broadcast from WEEI, WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).
5th; *Smith Brothers* (vocal and instrumental), WEAF; 10:00 to 10:30 P.M. (Also broadcast from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF).
6th; *Royal Typewriter* (orchestra and vocal), WGY; 9:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WSAI and WADC).

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6th; *Clicquot Club Eskimos*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ.)
6th; *Goodrich Zippers* (orchestra and vocal), WEAF, 10:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSI, WWJ, WSAI and WADC).
7th; *Happiness Boys* WEAF; 8:00 P.M.
7th; *Breyer Hour* (orchestra and vocal), WJZ and WRC; 9:00 P.M.
7th; *La France Orchestra*, WEAF; 9:30 P.M. (Also broadcast from WEEI, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).
8th; *New York Philharmonic Orchestra with Walter Damrosch*, WEAF; 9:15 P.M. (Also broadcast from WEEI, WGR, WFI, WCAE, WWJ, WSAI, WTAM, WGN, KSD, WCCO and WDAF).
9th; *Capitol Theatre Grand Orchestra*, WEAF; 7:20 P.M. (Also broadcast from KSD, WRC, WWJ, WJAR, WCAE and WTAG).
9th; *Atwater Kent Hour*, WEAF; 9:15 P.M. (Also broadcast from WJAR, WEEI, WFI, WCCO, WTAM, WGN, WFI, WCAE, WGR, WOC, WTAG, WWJ and KSD).
9th; *Godfrey Ludlow* (violinist); WJZ; 9:30 P.M. (Also from WGY).
9th; *Maxwell House Coffee Hour* (orchestra), WJZ, 10:15 to 11:15 P.M. (Also broadcast from WBZ, WRC, WGY and KDKA).
10th; *Willys-Overland Hour*, WJZ; 8:30 P.M.
10th; *A & P Gypsies*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ).
10th; *Fireside Boys*, WJZ; 9:50 P.M.
10th; *B. A. Rolfe's Palaise D'Or Orchestra*, WEAF, 11:00 to 12:00 M.
11th; *Champion Spark Pluggers*, WJZ, 8:00 P.M. (Also broadcast from WGY and WRC).
11th; *Vikings*, WEAF; 8:00 to 8:30 P.M. (Also broadcast from WEEI, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC).
11th; *Buckeye Bakers*, WEAF; 8:30 to 9:30 P.M. (Also broadcast from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG and WLIB).
11th; *Eveready Hour*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI and WTAG).
11th; *Keystoners*, WJZ; 9:00 P.M. (Also broadcast from WRC and WGY).
11th; *Auction Bridge Instruction*, WEAF; 10:00 P.M. (Also broadcast from WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO and KSD).
11th; *Cook's Tours*, WJZ; 10:00 P.M. (Also broadcast from WRC and WGY).
11th; *George Olsen's Orchestra*, WJZ; 10:45 P.M.
12th; *Eastman Theatre Orchestra*, WGY; 6:30 P.M. (Also from WHAM).
12th; *Daris Saxophone Octette*, WEAF; 8:30 P.M. (Also broadcast from WEEI, WJAR, WLIT, WRC, WTAG and WCAE).
12th; *Sixty White Minutes Orchestra*, WJZ; 9:00 P.M. (Also broadcast from WBZ, KDKA and KYW).
12th; *Ipana Troubadours*, WEAF; 9:00 to 9:30 P.M. (Also broadcast from WEEI, WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).
12th; *Smith Brothers* (vocal and instrumental), WEAF; 10:00 to 10:30 P.M. (Also broadcast from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF).
13th; *Royal Typewriter* (orchestra and vocal), WGY; 9:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSI, WWJ, WSAI and WADC).
13th; *Clicquot Club Eskimos*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ).
13th; *Goodrich Zippers* (orchestra and vocal), WEAF; 10:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, and WSAI).
14th; *Happiness Boys*, WEAF; 8:00 P.M.
14th; *Hohner Harmony Four*, WEAF; 8:30 to 9:00 P.M. (Also broadcast WEEI, WLIT, WGR, WRC, WCAE, WLIB, WTAM and WWJ).
14th; *Breyer Hour* (orchestra and vocal), WJZ and WRC; 9:00 P.M.
14th; *La France Orchestra*, WEAF; 9:30 P.M. (Also broadcast from WEEI, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).
15th; *New York Philharmonic Orchestra with Walter Damrosch*, WEAF; 9:15 P.M. (Also broadcast from WEEI, WGR, WFI, WCAE, WWJ, WSAI, WTAM, WGN, KSD, WCCO and WDAF).
16th; *Capitol Theatre Grand Orchestra*, WEAF; 7:20 P.M. (Also broadcast from KSD, WRC, WWJ, WJAR, WCAE and WTAG).
16th; *Atwater Kent Hour*, WEAF; 9:15 P.M. (Also broadcast from WJAR, WEEI, WFI, WCCO, WTAM, WGN, WFI, WCAE, WGR, WOC, WTAG, WWJ and KSD).
16th; *Godfrey Ludlow* (violinist), WJZ; 9:30 P.M. (Also from WGY).
16th; *Maxwell House Coffee Hour* (orchestra), WJZ; 10:15 to 11:15 P.M. (Also broadcast from WBZ, WRC, WGY and KDKA).

Trans-Oceanic Calls Heard

POPULAR RADIO *has now completed arrangements for forwarding to transmitting amateurs in England, France, Germany, Austria, Ireland and Italy all calls heard (QSL) cards that may be addressed to them by American amateurs care of this magazine. These cards will be delivered through local agents in those countries, who have or can obtain knowledge of the present address of the foreign amateurs. Plans have also been completed by this magazine for forwarding to transmitting amateurs in this country in turn all QSL cards that may be addressed to them by amateurs from those countries. American amateurs are invited to send their cards to foreign amateurs through this office, which will not only assure safe delivery through the special agencies which are thus provided, but which will publish a monthly list in a "Trans-oceanic Calls Heard" department.*

Address your cards to the foreign amateurs by call numbers and enclose them in envelopes to—

The Calls Heard Editor,
POPULAR RADIO
627 West 43d Street, New York

THE following stations were received and logged at the amateur station of D. O'Dwyer (GW-18B), 9 Upper Leeson St., Dublin, Irish Free State on an 0-v-l low-loss tuner.

U-1CMX—*July 25, 1926;* signal strength, R6; rectified AC note on 37 meters; no fading.

U-1BXH—*August 8, 1926;* signal strength, R3; rectified AC note on 41 meters; very bad fading.

U-1AAO—*July 11, 1926;* signal strength, R7; rectified AC note on 37 meters; no fading.

THE following stations were received and logged at the amateur station of A. Pelletier (FR-284), 23 Rue Bardinet, Paris-14e, France on a Bourne receiver with a detector and one stage of audio using a single-wire, inside antenna 12 meters long. The last seven stations were logged on a Vesla receiver.

U-4IZ—*October 3, 1926;* signal strength R7; calling CQDX; steady rectified AC note; very loud; no fading.

U-4WJ—*October 3, 1926;* signal strength R6; calling U-1AWE; rectified AC note, steady; no fading.

U-3AY—*October 1, 1926;* signal strength R6; calling CQ; steady AC note; no fading.

U-3DD—*October 1, 1926;* signal strength R6; calling U-9ARA; steady DC note; no fading.

U-4TK—*October 3, 1926;* signal strength R5; calling CQ France; rectified AC note, steady; no fading.

U-3CJ—*October 4, 1926;* signal strength R5; steady DC note; calling CQ; no fading.

U-8BRC—*October 5, 1926;* signal strength R7; calling U-9AOI; very steady DC note; no fading.

U-8ATV—*October 5, 1926;* signal strength R6-R7; calling BZ-1AK; rectified, steady AC note; no fading.

U-8BEN—*October 4, 1926;* signal strength R6; calling M-1J; steady AC note, 50 cycles; no fading.

U-4SB—*October 4, 1926;* signal strength R6; calling M-9A; rectified AC note, steady, no fading.

U-4RN—*October 5, 1926;* signal strength R6; calling CQ; steady rectified AC note; no fading.

U-9BPB—*October 4, 1926;* signal strength R6; calling CQ; rectified AC note, steady; no fading.

DOUBLE IMPEDANCE

Audio Amplification

QUALITY and VOLUME:—Double impedance audio amplification quadruples the power output of audio tubes as no magnetic coupling is used. The grid can thus swing positive as well as negative, as positive grid currents do not substantially affect the wave shape. This effect is not possible without grid inductance as "tube blocking" develops before the overloading point is reached. The design of the units can be such as to give any frequency curve desired, making it possible to obtain perfect quality.

KENNETH HARKNESS

Has selected this system for his KH-27 receiver for these reasons. His extensive research on audio amplifiers in order to obtain the best possible results convinced him that **double impedance** was the ultimate solution to the problem.

COMPACT UNITS

Using figure "8" laminations can now be obtained through the following licensed manufacturers:

K. H. Radio Laboratories, Inc.
124 Cypress Avenue, N. Y. C.

Ford Radio & Mica Corporation
111 Bleecker St., N. Y. C.

Paragon Electric Corp.
14 Alvin Place, Upper Montclair, N. J.

American Specialty Company
Bridgeport, Conn.

YOUR PRESENT RECEIVING SET

Can be changed over very easily by the use of these units. Any of these manufacturers will gladly supply full data as to how to modernize and perfect your set. A complete factory built receiver is being made by the Paragon Electric Corp. which incorporates these units. These manufacturers are operating under

BROAD BASIC PATENTS

Issued to and protected by the Hiler Audio Corp. Look for "Licensed under Hiler Patent 1589692."

HILER AUDIO CORP.

10 Argyle Terrace Irvington, N. J.
Terrace 4210

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UNIVERSAL

Two New Companions

TRANSOCEANIC "NEW PHANTOM"

SEVEN TUBES—100% SHIELDING—TUNES 35 METERS TO 3600 METERS

$220.00 (No Accessories)

"On The Air

Compare These Features With Any Radio

***Indicates Original Golden-Leutz Feature as Applied to Broadcast, Receivers, # Exclusive Feature**

		Golden-Leutz Transoceanic	Any Other Radio
1.	100% shielding—Interstage shielding—Complete external shielding against extraneous disturbances*	√	
2.	Totally shielded low loss variable condensers to prevent interaction between condenser and transformer fields* #	√	
3.	Complete shielding between stators (grid circuit) of multiple condensers*, practically no shield losses	√	
4.	Use of Indicating Meters and special switch to read "A," "B" and "C" battery voltages*, total of 8 readings	√	
5.	Licensed under Hogan Patent 1,014,002 for single control (first licensee)*	√	
6.	Optional individual control or simultaneous control of all tuning controls*, instantly changeable	√	
7.	Use of interchangeable tuned radio frequency transformers to tune all broadcast wavelengths in the world, viz., 35 to 3600 meters*	√	
8.	A special filter circuit in the output to exclude detrimental plate current from the Loud Speaker	√	
9.	Use of Resistance Coupling in the Audio Amplifier, combined with impedance and transformer coupling for perfect reproduction* #	√	
10.	Adjustable Antennae Coupling to adapt set to all various types and sizes of broadcast antennae* #	√	
11.	Antennae Series Condenser for Extreme Selectivity in congested districts* # distant reception through locals possible	√	
12.	Sealed Chassis to exclude moisture and dust* #, equally suited to any climate in the world	√	
13.	Last stage, power audio, adaptable to 201A, 112,171 or 210 tubes, 550 volts maximum capacity for great volume* #	√	
14.	Separate B Voltage Taps for Detector, Radio Amplifiers, Audio Amplifiers and Power Amplifiers* adaptable to all tubes	√	
15.	Separate Bias Voltage Taps for Radio Amplifier, Audio Amplifiers and Power Amplifiers* adaptable to all tubes	√	
16.	Power Audio Tube Filament arranged for heating by either battery or alternating current*	√	
17.	No rivets to corrode, all connections soldered in accordance with Navy Specifications*	√	
18.	Only piece of steel used is in condenser shafts, detrimental steel supports purposely omitted, all other material non-magnetic	√	
19.	Metallized heavy current carrying, permanent value grid leaks and resistors	√	
20.	Direct Disc Vernier Adjustments, etched black dials, silver graduations 0 to 100	√	
21.	Indicating rotors upon which calibrations can be recorded for reference, all calibrations permanent	√	
22.	All insulating material Genuine Bakelite include sub-panels—coil bases—coil forms. Sockets new UX-type positive contact	√	
23.	All Screws, Bolts and Nuts securely fastened by bronze lock washers* #	√	
24.	Most Compact Multiple Tube Sets made, 9 tube less than 2 cubic feet; 7 tube less than 1 cubic foot. Dimensions 27⅞ x 13 1/16 x 8"	√	
25.	Scientifically determined distance between transformers and shield, not detrimentally close* #	√	
26.	Volume Control device to regulate volume to any desired value without affecting quality	√	
27.	Can be used with "B" and "C" Eliminators, special Golden-Leutz Eliminator made to match	√	
28.	Practically all parts, except the meter and a few small parts, are manufactured in our factory	√	
29.	Each receiver tested at night and calibrated to a station at least 2000 miles distant, insuring long range performance	√	
30.	Design by Charles R. Leutz	√	

GOLDEN-LEUTZ, INC.

"Manufacturers of the Highest Class Radio Apparatus in the World"

MAIN OFFICE AND WORKS:

SIXTH & WASHINGTON AVENUES, LONG ISLAND CITY, NEW YORK, U. S. A.

Cables: "Experinfo" New York—All Codes

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TRANSOCEANIC

to the "SILVER GHOST"

TRANSOCEANIC "PHANTOM"

NINE TUBES—100% SHIELDING—TUNES 35 METERS TO 3600 METERS

$250.00 (No Accessories)

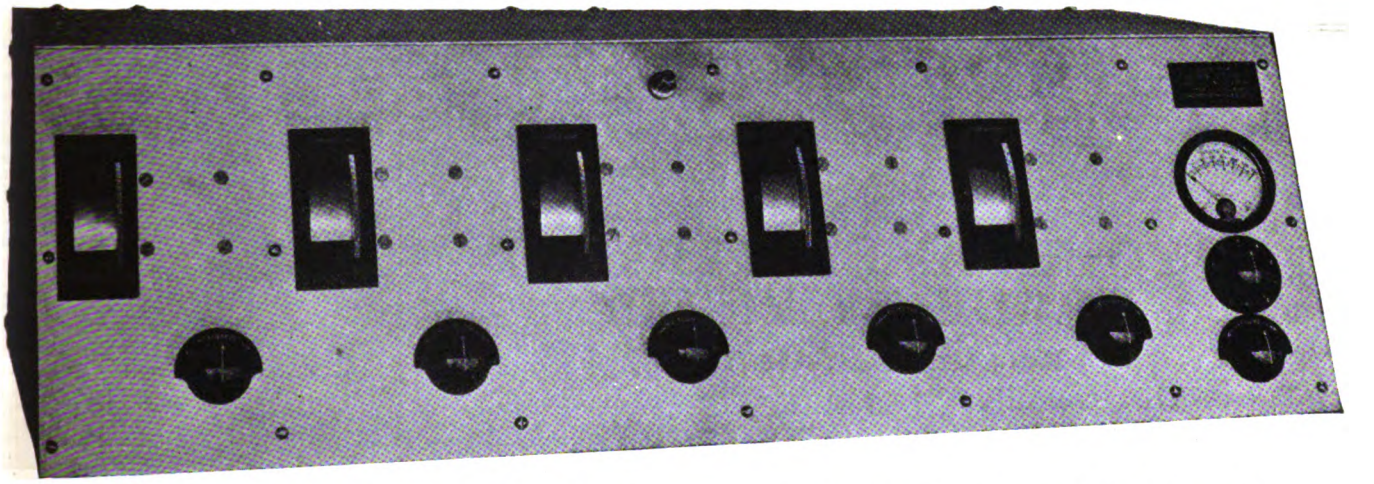
To Everywhere"

Phantom Models are now installed on the U. S. S. Vega and U. S. S. Utah.

"MOST POWERFUL IN THE WORLD"

We are now ready to demonstrate that the Phantom Model has a far greater range, greater degree of selectivity, easiest means of operation, finest electrical design and construction and the best quality of musical reproduction as compared with any radio broadcast receiver in the world.

9 TUBE TRANSOCEANIC "PHANTOM"



Universal Transoceanic "New Phantom"

Item	Quan.	DESCRIPTION	Price
1	1	Universal Transoceanic "New Phantom" Broadcast Receiver, 7 tubes, 2 tuned radio, detector, three audio and power audio amplifier. Including "A" Transformers for 200 to 560 meters tuning range. (No accessories included)	$220.00
		EXTRAS	
2	1	Set selected tubes including detector and 210 power tube	21.50
3	1	Set "B" Transformers for tuning 80 to 210 meters	15.00
4	1	Set "C" Transformers for tuning 35 to 90 meters	15.00
5	1	Set "AA" Transformers for tuning 500 to 1500 meters	15.00
6	1	Set "BB" Transformers for tuning 1200 to 3600 meters	15.00
7	1	6 volt 120 A.H. Storage Battery	24.00
8	1	New Type Farrand Senior Loud Speaker, Cone Type	32.50
9	1	Golden-Leutz Special Current Supply for 110 volts 50/60 cycle A.C.	135.00
10	1	Antennae Equipment	4.00
		Total all accessories	$497.00
11	1	Complete Knocked Down Kit of all Transoceanic "New Phantom" Parts ready for assembly including constructional Drawings (no accessories), "A" Type Transformers for 200 to 560 meters included	$190.00
12	1	Complete set of Constructional Drawings and Operating Data on Transoceanic "New Phantom" only	2.00

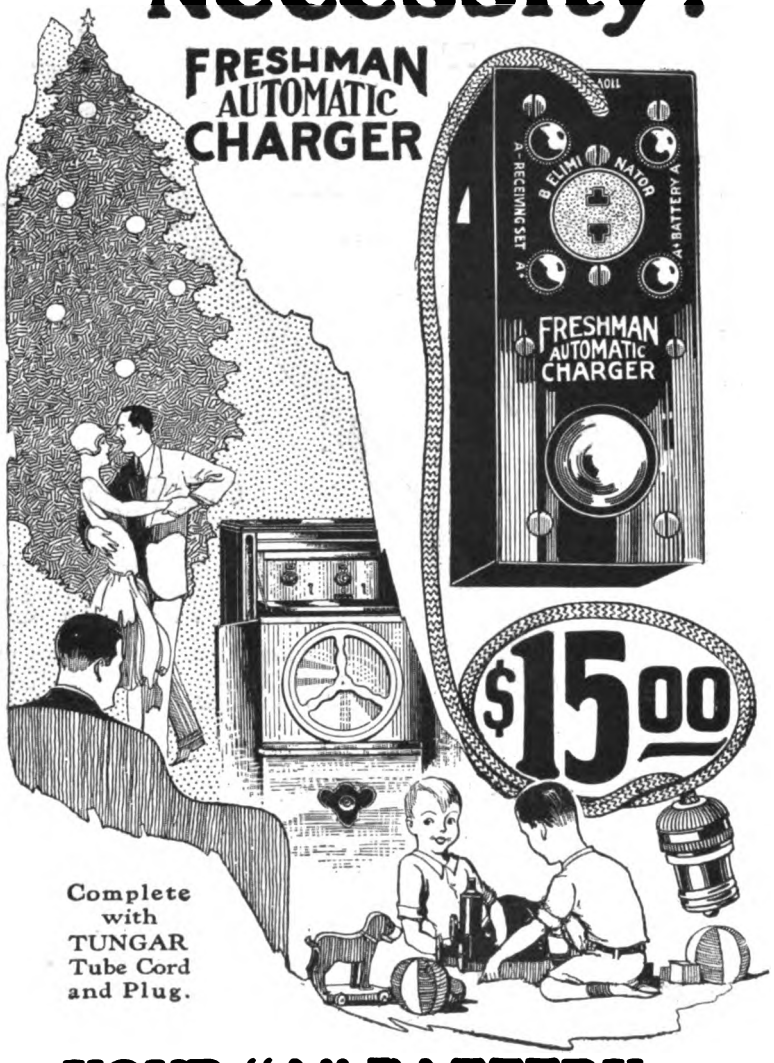
Special quotation for dry "B" battery operation will be made on request

Universal Transoceanic "Phantom"

Item	Quan.	DESCRIPTION	Price
1	1	Universal Transoceanic "Phantom" Broadcast Receiver, 9 tubes, 4 tuned radio, detector, three audio and power audio amplifier. Including "A" Transformers for 200 to 560 meters tuning range. (No accessories included)	$250.00
		EXTRAS	
1	1	Set selected tubes including detector and 210 power amplifier	25.50
3	1	Set "B" Transformers for tuning 80 to 210 meters	25.00
4	1	Set "C" Transformers for tuning 35 to 90 meters	25.00
5	1	Set "AA" Transformers for tuning 500 to 1500 meters	25.00
6	1	Set "BB" Transformers for tuning 1200 to 3600 meters	25.00
7	1	6 volt 120 A.H. Storage Battery	24.00
8	1	New Type Farrand Senior Loud Speaker, Cone Type	32.50
9	1	Golden-Leutz Special Current Supply for 110 volts 50/60 cycle A.C.	135.00
10	1	Antennae Equipment	4.00
		Total all accessories	$571.00
11	1	Complete Knocked Down Kit of all Transoceanic "Phantom" Parts, ready for assembly including constructional drawings (no accessories). "A" Transformers for 200 to 560 meters included	$220.00
12	1	Complete set of Constructional Drawings and Operating Data for Transoceanic "Phantom" only	2.00

Special quotation for dry "B" battery operation will be made on request

An Absolute Necessity!



YOUR "A" BATTERY TROUBLES ENDED

Requires No Attention

This remarkable device keeps quietly working for you all the time that your set is not in operation. It is controlled by the switch of your set which disconnects the charger automatically when you are using your radio. And, when you turn off your set it immediately resumes charging the "A" battery again.

Foolproof and Dependable

Whether it is a radio dance that you are giving or an excited assemblage listening to the results of a World's Championship sporting event you never need have fear of the broadcasting fading away through rundown "A" batteries; a condition which has happened so many times in the past to practically all owners of radio sets.

Our new 48 page book illustrating all Freshman Products is now ready. Write for it—free

CHAS. FRESHMAN CO., INC. · Freshman Bldg., New York

Changes in the List of Broadcasting Stations in the U. S.

These corrections and additions to the list which was published in the March, 1926, issue of POPULAR RADIO *(together with the changes which have been published in succeeding months) make the list correct as of December 1, 1926. Further changes will be published each month in this magazine.*

STATIONS ADDED

KFKB	Milford, Kansas	431.4
KGDA	Dell Rapids, South Dakota	254.1
KGDI	Seattle, Washington	416.4
KGDJ	Cresco, Iowa	202.6
KGDM	Stockton, California	217.3
KRAC	Shreveport, Louisiana	220.0
KRLD	Dallas, Texas	357.1
KRSC	Seattle, Washington	499.7
KSOO	Sioux Falls, South Dakota	360.0
KWTC	Santa Ana, California	260.7
WAGS	Sommerville, Massachusetts	250.0
WARS	Brooklyn, New York	295.0
WCGU	Lakewood, New Jersey	350.6
WEPS	Gloucester, Massachusetts	295.0
WFBE	Cincinnati, Ohio	232.4
WGWB	Milwaukee, Wisconsin	384.4
WHOG	Huntington, Indiana	241.8
WICC	Bridgeport, Connecticut	285.0
WKBW	Buffalo, New York	362.5
WKBY	Danville, Pennsylvania	220.0
WKBZ	Ludington, Michigan	256.3
WLBC	Muncie, Indiana	223.7
WLBE	Brooklyn, New York	230.6
WLBF	Kansas City, Missouri	211.1
WOMT	Manitowoc, Wisconsin	254.1
WRES	Wollaston, Massachusetts	300.0

STATIONS DELETED

WCAP	Washington, D. C.	468.5
WFBE	Seymour Indiana	225.4

CHANGES IN CALL LETTERS

WBBS	New Orleans, La.	*change to*	WKBT
WFBH	New York City	*change to*	WPCH
WQAC	Amarillo, Tex.	*change to*	KGRS

CHANGES IN WAVELENGTHS

KFEC	Portland, Ore., 247.8	*change to*	252.0
KFI	Los Angeles, Cal., 468.5	*change to*	467.0
KFPY	Spokane, Wash., 273	*change to*	272.6
KFQD	Anchorage, Alaska, 227.1	*change to*	300.0
KFUT	Salt Lake City, Utah, 260.7	*change to*	283.0
KFXF	Denver, Col. 249.9	*change to*	430.1
KQCG	Newark, Ark., 243.2	*change to*	239.9
KQCH	Wayne, Neb., 450	*change to*	434.5
KJBS	San Francisco, Cal., 220.4	*change to*	234.2
KNRC	Santa Monica, Cal., 208.2	*change to*	238.0
KSMR	Santa Maria, Cal., 209.7	*change to*	282.8
KSO	Clarinda, Ia., 241.8	*change to*	405.2
KWCR	Cedar Rapids, Ia., 277.6	*change to*	296.0
WCAM	Camden, N. J., 236.1	*change to*	336.9
WFRL	Brooklyn, N. Y., 205.4	*change to*	329.5
WGM	Jeanette, Pa., 372	*change to*	299.0
WJAF	Ferndale, Mich., 400	*change to*	407.0
WJBT	Chicago, Ill., 238	*change to*	468.5
WJBY	Gadsden, Ala., 270.1	*change to*	280.0
WMAL	Washington, D. C., 212.6	*change to*	283.9
WNJ	Newark, N. J., 252	*change to*	350.0

CHANGES IN LOCATIONS

KFXF	Colorado Springs, Col.,	*change to*	Denver, Col.
KNRC	Los Angeles, Cal.,	*change to*	Santa Monica, Cal.
WOOD	Grand Rapids, Mich.,	*change to*	Furnwood, Mich.
WRNY	New York City,	*change to*	Coytesville, N. J.
WSWS	Woodale, Ill.,	*change to*	Batavia, Ill.

Is the Klu Klux Klan After Jewish Program Features?

WHAT is reported as "the first case of vandalism directed against a broadcasting station" occurred on the evening of November 12th, when the cable leading to the antenna of station WRNY was mysteriously cut during the broadcasting of a Jewish religious service from Temple Emanu-El in New York. WRNY is owned by Hugo Gernsback, and directed by C. D. Isaacson.

* *

A Call List for All the World

DX FANS should be interested in an "International List of Radio Stations of the World" that has just been made available in an English edition. This world-wide call list may be procured from the International Bureau of the Telegraphic Union, Berne, Switzerland.

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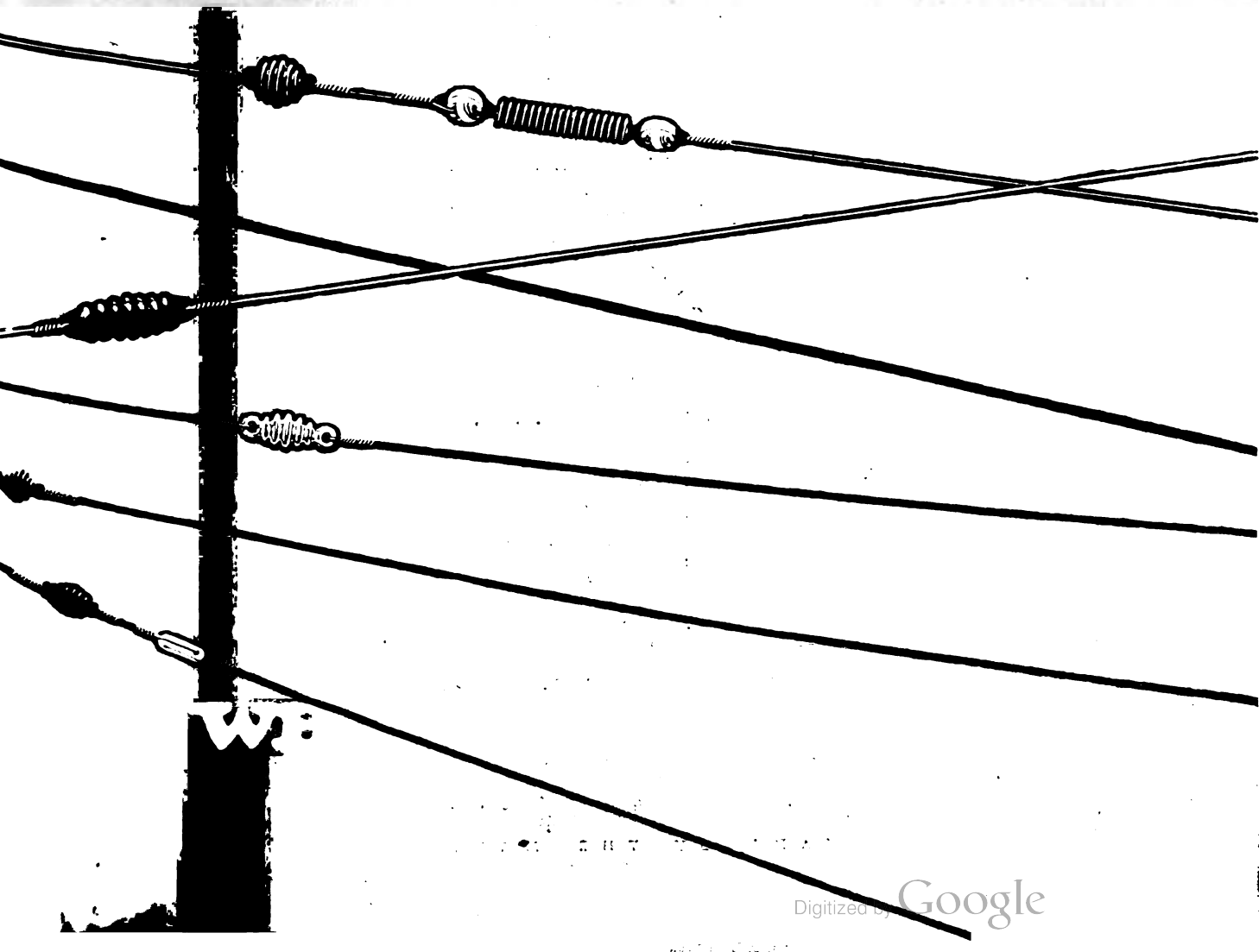
Popular Radio

★ FEBRUARY · 1927

25¢



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SEEING MORE THAN THE MICROSCOPE

. . . . .

Electrons, which are very important in radio, are too small for any microscope to make visible. Yet our eyes can watch their paths —study their habits.

In the laboratories where Radiotrons are studied there are instruments which make all these things possible—and more. Knowing how many electrons leap across from the filament to the plate of a vacuum tube is in its way as abstruse a study as the measurement of distant stars by astronomists. Yet this abstruse research has a definite application in the RCA Radiotron in your radio set. That is why the laboratories back of RCA spend millions in scientific research that is far too much like "pure science" for an ordinary manufacturer.

Radiotrons are improved and new ones are developed, to make radio better. Because this research shows in *results*, Radiotron users keep five great factories busy!

Watch your tubes, always, for the RCA mark. You will find it on Radiotrons for *every purpose*.

. . . . .

RCA

clear up the tone

Do you get a blast when you turn the volume up a bit? Do you get sweet, clear tone at low volume, but noise when it's louder? The trouble's probably right in one tube—the tube in the last audio stage. The Radiotron laboratories discovered that no ordinary tube can let big volume through clearly. Change one tube to an RCA power Radiotron. *Then* turn up the volume . . . . and it comes through *clear!*

Bring your storage battery set up-to-date with
a power RADIOTRON UX-171 or UX-112
a detector RADIOTRON UX-200-A
and RADIOTRONS UX-201-A for all-round quality.

Bring your dry battery set up-to-date with
a power RADIOTRON UX-120
and RADIOTRONS UX-199 for all-round quality

RADIO CORPORATION OF AMERICA - NEW YORK - CHICAGO - SAN FRANCISCO

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA

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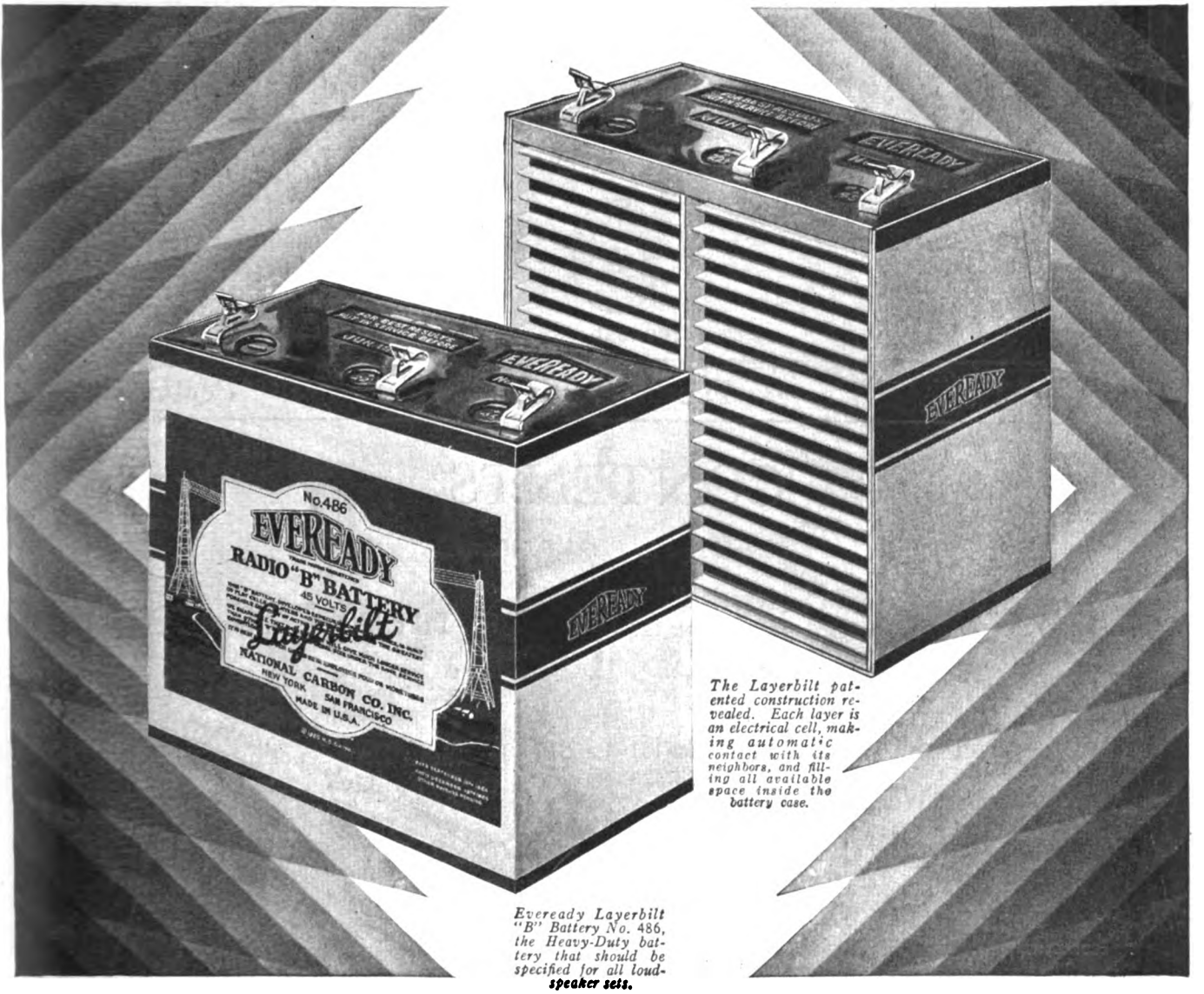

The Layerbilt patented construction revealed. Each layer is an electrical cell, making automatic contact with its neighbors, and filling all available space inside the battery case.

Eveready Layerbilt "B" Battery No. 486, the Heavy-Duty battery that should be specified for all loud-speaker sets.

This is the Heavy-Duty Battery in which the new Layerbilt construction provides greater economy

THERE'S an important discovery in radio economy awaiting all users of loud-speaker sets who have been buying the smaller Light-Duty "B" batteries instead of the large Heavy-Duty size required by such sets. Because the Light-Duties cost somewhat less to buy they seem like an economy, but the surprising fact is that the Eveready Layerbilt No. 486 lasts more than twice as long though it does not cost anywhere near twice as much. It is, therefore, much more economical—we believe it to be the most economical "B" battery ever built. Certainly it has proved this by laboratory tests and the service it has given to radio listeners in their own homes during the past eighteen months.

Eveready Layerbilt's remarkable life is due to its unique construction. All other dry cell "B" batteries are assembled of cylindrical cells, with much waste space between them, and many soldered connections bridging the gaps.

Several years ago we struck boldly out, away from this tradition, seeking a better method. We wanted to avoid waste space, minimize soldering, and get more current and longer life from a given quantity of active materials. The Eveready Layerbilt is the result.

This patented, exclusive battery is built in layers of flat current-producing elements, making automatic connection with each other. Every available inch inside the battery is occupied usefully. You get more battery for your money, and that battery is more efficient.

Remember this about "B" batteries: All loud-speaker sets require Heavy-Duty batteries, and the Eveready Layerbilt has proved time and again to be the longest lasting and most economical Heavy-Duty "B" battery.

Manufactured and guaranteed by

NATIONAL CARBON CO., INC.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

Tuesday night is Eveready Hour Night—9 P. M., Eastern Standard Time, through the following stations:

WEAF–*New York*
WJAR–*Providence*
WEEI–*Boston*
WTAG–*Worcester*
WFI–*Philadelphia*
WGR–*Buffalo*
WCAE–*Pittsburgh*
WSAI–*Cincinnati*
WTAM–*Cleveland*
WWJ–*Detroit*
WGN–*Chicago*
WOC–*Davenport*
WCCO–*Minneapolis & St. Paul*
KSD–*St. Louis*
WRC–*Washington*

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Popular Radio

EDITED *by* KENDALL BANNING

FOUNDED 1911

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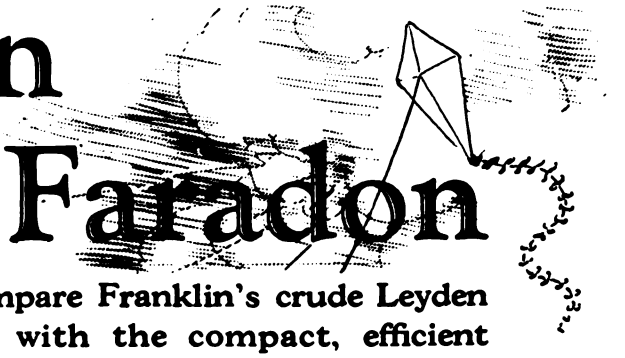
from Franklin *to* Faradon



Compare Franklin's crude Leyden Jar with the compact, efficient Faradon Capacitor of modern radio.

Model WS By-Pass Unit

Made in
½ M F D
1 M F D
and 2 M F D
Units

The Wireless Specialty Apparatus Company, established in 1907, manufacturers of Faradon, specializes in electrostatic condensers for all purposes.

For Dependability

insist upon Faradon equipment for your radio set and battery eliminator.

Wireless Specialty Apparatus Company

Jamaica Plain, Boston, Mass., U. S. A.

Made in U. S. A.

Price $10.50

Model WS-3750 "Universal" Filter Capacitor Block

Other models in blocks or individual units with any desired capacities and voltage ratings.

Faradon By-Pass and Filter Capacitors

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A Page With The Editor

From a photograph made for Popular Radio

How Popular Radio Helps Its Readers and the Manufacturers of Radio Receivers and Radio Parts—

by maintaining a well-equipped electrical-testing laboratory and a staff of engineers whose duty it is to test every piece of radio apparatus as soon as it is placed on the market by the manufacturers, and to place this data at the disposal of Popular Radio *readers. A report on every set or part tested by the* Popular Radio Laboratory *telling the class of apparatus, giving the usages and outstanding features and describing the apparatus tested, appears monthly in the enlarged department, "What's New In Radio." This department is being used more and more by the readers of* Popular Radio *as a "buyer's guide" and by the retail and jobber trade as a catalogue of the better apparatus to stock and to supply to their consumers.*

On page 136 are given the prize winners of the contest for the best answer to the questions "How Can Radio Broadcast Programs Be Improved," which was announced in the September number of this magazine.

* *

The task of selecting the prize winners was no easy one.

* *

After all of the letters had been considered, a preliminary selection of 16 was made. These 16 letters (which received the highest marks of the judges) were then re-submitted and reduced to 6. And from these surviving 6 the final selections were made.

* *

One of the noteworthy features of the contest was the number of suggestions of "staggering" radio programs of a group of stations so that at any hour the listener could select a feature that interested him most. This was the suggestion that won the first prize for Mr. W. A. Mackay. Among others who presented particularly able arguments for this form of organization of programs were Edward T. Vaille, I. E. Morrison, W. P. Miller, Vernon May, Charles Cohen and K. M. MacIlvain.

Several contestants proposed that each broadcasting station specialize in some one form of program—jazz, grand opera, lectures, sports, topical songs, religious services, symphonic music or whatever the facilities of the station permit.

* *

Among other suggestions were many of an original and unusual nature, most of which reflected a serious study of the subject.

* *

For instance, George D. Keller, who evidently has a lottery complex, suggests that the stations mail to their lists of fans a letter like this:

* *

"We assume that you are grateful to the artists who, at no expense to you, make our programs possible. You have shown us by your letters that you appreciate the efforts put forth by this station to entertain you. In order to stimulate your response and to broaden your field of cooperation we will mail to you upon request a postal card addressed to this station. Each card contains five coin receptacles and under the flap of each receptacle is a number. Once every month we will conduct a drawing at this station and valuable prizes will be awarded to the holders of the lucky numbers. Put a dime into one of the coin receptacles in order to qualify in these contests; the more dimes you put into the card, the better chance you will have of drawing the lucky number. There is a questionnaire printed on each card and your answer to the questions contained thereon will determine the class of programs that we will broadcast in the future. Your cooperation will assist us in paying for the services of talented musicians and in paying the royalties required for the privilege of broadcasting copyrighted music."

* *

"Get rid of the beginner, the has-beens and the never-will-be's who are now cluttering up air programs" is the gist of several letters.

* *

For every station to devote each day of the week to a specialized program—devoting Sunday to church services, Monday to lectures, Tuesday to dramas, Wednesday to popular songs, Thursday to jazz, Friday to classical music and Saturday to a *pot pourri*—is the novel suggestion of Henry F. Behre of San Francisco.

* *

And a *very* large percentage of the contestants suggested that religious services be reduced, and confined on Sundays to the morning hours only.

* *

Altogether, the contest was illuminative and instructive, and the many ideas that were set forth were automatically brought to the attention of those who are in positions to act upon them.

* *

In the coming issue of Popular Radio—for March—will appear two constructional articles of unusual interest to the experimenter.

* *

One article will give the complete constructional details of a loudspeaker that can be built at home at a cost of about $15.00.

* *

And the other article will tell how to build a single-tube receiver that will cost about $25.00, and that will *operate a loudspeaker*—by means of a new type of valve that may be made to do the work that it ordinarily takes four or five tubes to do.

Kendall Banning

Editor, Popular Radio

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POPULAR RADIO Is an Authoritative Source of Information

"I have always found POPULAR RADIO *to be an interesting and thoroughly reliable source of information in which the broadcast listener may find the newest and most important developments in radio described in a non-technical manner, as well as technical articles for the more advanced fan."*

PRESIDENT, BROADCAST LISTENERS
ASSOCIATION OF AMERICA

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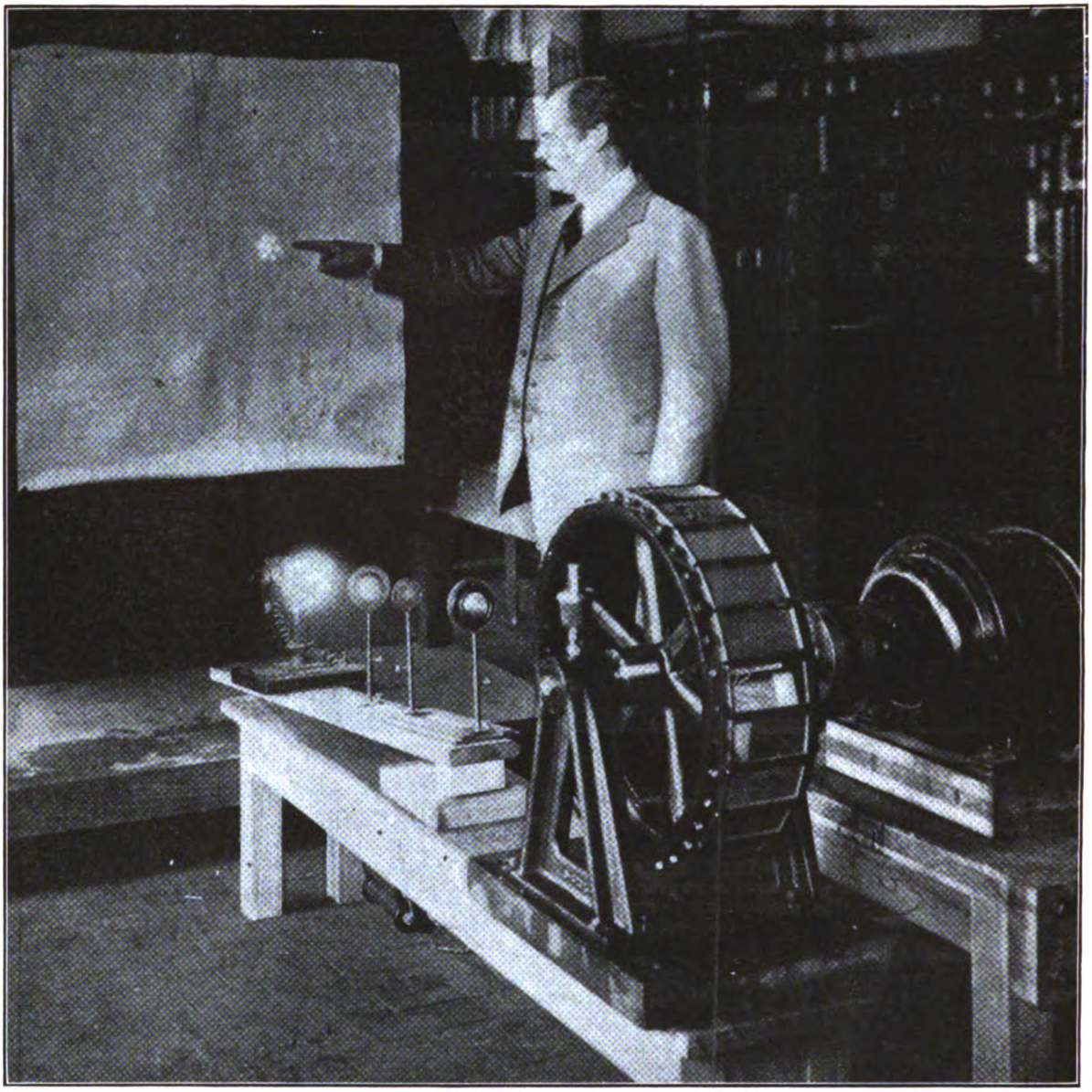

A "Blackboard" Demonstration that May Some Day be Visible in the Classrooms of All the World

The eminent engineer Mr. E. F. W. Alexanderson has just announced that the work on his new device for projecting pictures by radio has "already proved that the expectation of television is not unreasonable and may be accomplished with means that are in our possession at the present day." Previous television devices have been demonstrated by C. F. Jenkins, Edouard Belin and J. L. Baird. When this dream of the scientists is eventually realized, it will open up extraordinary possibilities in educational work—not only to schools and colleges but to the public generally. Mr. Alexanderson's projector (shown above) is composed of seven light sources which are converged onto a revolving drum which carries twenty-four mirrors. By means of this device, a "still picture" may be transmitted by radio in two minutes; to transmit moving pictures by radio, this speed must be increased about 600 times. To attain this speed is the problem that is yet to be solved by the inventors.

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Popular Radio

VOLUME XI February, 1927 NUMBER 2

THE COMING OF THE

"RADIO UNIVERSITY"

Broadcasting is beginning to break down the artificial barriers which have surrounded that "education" which has long been reduced to courses framed by our colleges and dispensed only to our youth. How some of our universities and schools are now seeking to take advantage of the larger opportunities that radio offers is told in this article (the first of a series) by—

BRUCE BLIVEN

RADIO broadcasting began as a toy. Then it mushroomed suddenly into a gigantic amusement enterprise, which has grown so rapidly that nobody can keep pace with it. The next and most important step is still ahead. Radio will become an integral part of our whole civilization. It will bring about changes in every way comparable to those which followed the invention of printing in the fifteenth century.

In particular, radio is destined to have tremendously significant effects upon education.

It is somewhat surprising to me that despite all the talk and writing about radio in the past three or four years, so little attention has been paid to this aspect of its future usefulness. To be sure, we have had plenty of cocksure prophecies that it would "take the place of the classroom," or "do away with textbooks," prophecies so absurdly impossible of fulfillment that they hardly need to be refuted. What we have not had is any really serious study of radio as an educational force. Just what is it good for? What is it doing today? What may we reasonably expect in the not too distant future, basing our prediction on a study of the facts and sternly resisting the tendency to romanticize? These are the questions which I shall seek to answer in this article.

They are already important questions. Radio, even now, is one of the greatest media in existence for the dissemination of ideas. It is of course the speediest mechanism ever devised; and before very long as many people will be accessible by way of the ether as can now be reached by newspapers. (While the number of newspapers printed is still far larger than the number of receiving sets, there is great duplication of circulation among readers, one person buying several papers a day; and though a newspaper can be read by only one person at a time, when the loudspeaker is going most of the members of the family perforce have to hear what the radio has to say.)

The day is not far distant, then, when broadcasting will be the biggest single means of arguing to, or enlightening, the people. It is already one of the two most effective, the motion picture being the other. People had been talking and listening for many thousands of years before they learned to read and write, and most of us handle these new tools rather awkwardly even yet. Something we can see or hear is much more effective than something which we must translate from arbitrary symbols on paper into sounds and then words. It can readily be demonstrated that people will absorb ideas over the radio when they are "too tired to read"; and that they will get ideas out of the air which are too difficult for them to get in other ways.

In a sense, of course, the whole development of the radio has been educational. The amateur builder who puts together his own set—the DX hound who studies geography by way of the dials—the licensed amateur operator who talks at 3 A. M. with a man half a world away; all these are in the most real sense pushing back their mental horizons, getting that new and broader view of the world they live in, which is one of the chief ends of education. Even the casual listener who tunes in and out haphazardly on football games, dance music, speeches, symphony concerts and advertising talks picks up a great deal more information than he realizes; and while much of it is of little or no use, a good percentage is valuable.

With these aspects of the subject, however, it is not at present my purpose

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to deal. I wish to report on the more formal use of broadcasting as a definite part of a systematic educational effort, both for children and adults. When we turn to this phase of the matter we find that radio is already being used, and very seriously, for the dissemination of information. Indeed, I doubt whether anyone, even among those who are engaged in the business, realizes to what an extent this is true, unless he has looked into it carefully as the writer has just done.

Already the number of people who are getting useful information from the radio regularly week by week is at least four times as large as the total enrollment in all the colleges and universities of the country—and this despite the fact that the number of college students has itself doubled in the past ten years.

One of the most important educational developments is, in fact, the broadcasting of college lectures. All over the country, leading institutions are giving extension courses over the air, as a by-product, so to speak, of their regular work. New York University, Columbia, Union College, Syracuse University, the State Universities of Michigan, Minnesota, Iowa, Nebraska, the University of Pittsburgh, the Kansas State Agricultural College, the Michigan State College, are but a few of fully fifty institutions of higher learning which are regularly using the radio. Numerous other institutions coöperate with broadcasting stations on occasion. For example, the University Extension Division of the Massachusetts State Department of Education broadcasts, through station WBZ, the Westinghouse Company at Springfield, Mass., a series of courses in which members of the faculty at Harvard, Yale, Amherst, Massachusetts Institute of Technology and other institutions appear before the microphone. The Edison station at Boston, WEEI, has a course in which no fewer than thirty college presidents speak over the air. These include the heads of Wellesley, Smith, Bowdoin, Radcliffe, Clark, Mt. Holyoke, Williams, Amherst, Brown, Wesleyan and the Massachusetts Institute of Technology.

I have before me letters from almost a score of the leading radio stations of the country, narrating their experience in broadcasting educational material, and from them I am able to draw the typical picture of educational broadcasting as it exists today. The lectures are usually given by college professors in some nearby institution. They are given in the late afternoon or early evening, and a typical course is eight or ten lectures on one subject, each fifteen to thirty minutes in length.

It is now the general custom to invite listeners to write in and get a syllabus or other printed material, for which they usually pay a small fee, not more than $1 each. This has a double purpose: it does in fact help the listener to follow the course, and it also lets the broadcaster know how many people are seriously interested in each subject offered. In some cases written work is asked for and sent in by the students; but this is exceptional. Also unusual, but rapidly becoming less so, is the broadcasting of instructions for laboratory work of various sorts, including experiments in physics, chemistry, etc.

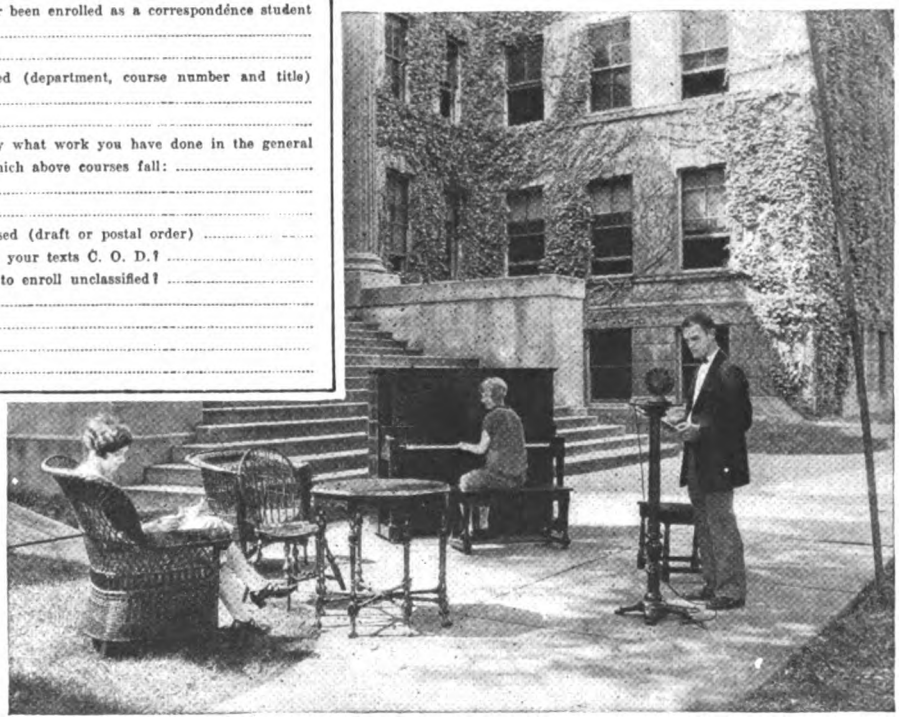
Generally speaking, the colleges have

RADIO CORRESPONDENCE COURSES
Application for Credit Enrollment

Name .....
Mailing address .....
Permanent address .....
Age.....Date of application .....
Present occupation .....
Elementary grades: where and when .....
.....
High school: where and when .....
..... Graduate?.....
Colleges and universities attended with dates of attendance and degrees received .....
.....
.....
.....
Do you want graduate or undergraduate credit for this course? .....
.....
Have you ever been enrolled as a correspondence student with us? .....
.....
Courses desired (department, course number and title)
.....
.....
State definitely what work you have done in the general subjects in which above courses fall: .....
.....
.....
Amount enclosed (draft or postal order) .....
Shall we send your texts C. O. D.? .....
Do you wish to enroll unclassified? .....
Remarks: .....
.....
.....
.....

A University That Gives Credits for Radio Courses

The University of Iowa has for two years offered "Radio Correspondence Courses" of twelve lectures each. The enrollment fee is $2.00, supplemented by written assignments, required reading and examinations. Satisfactory completion of these courses gives the student a credit of two semester hours on the University work. The courses are broadcast from station WSUI at Iowa City.



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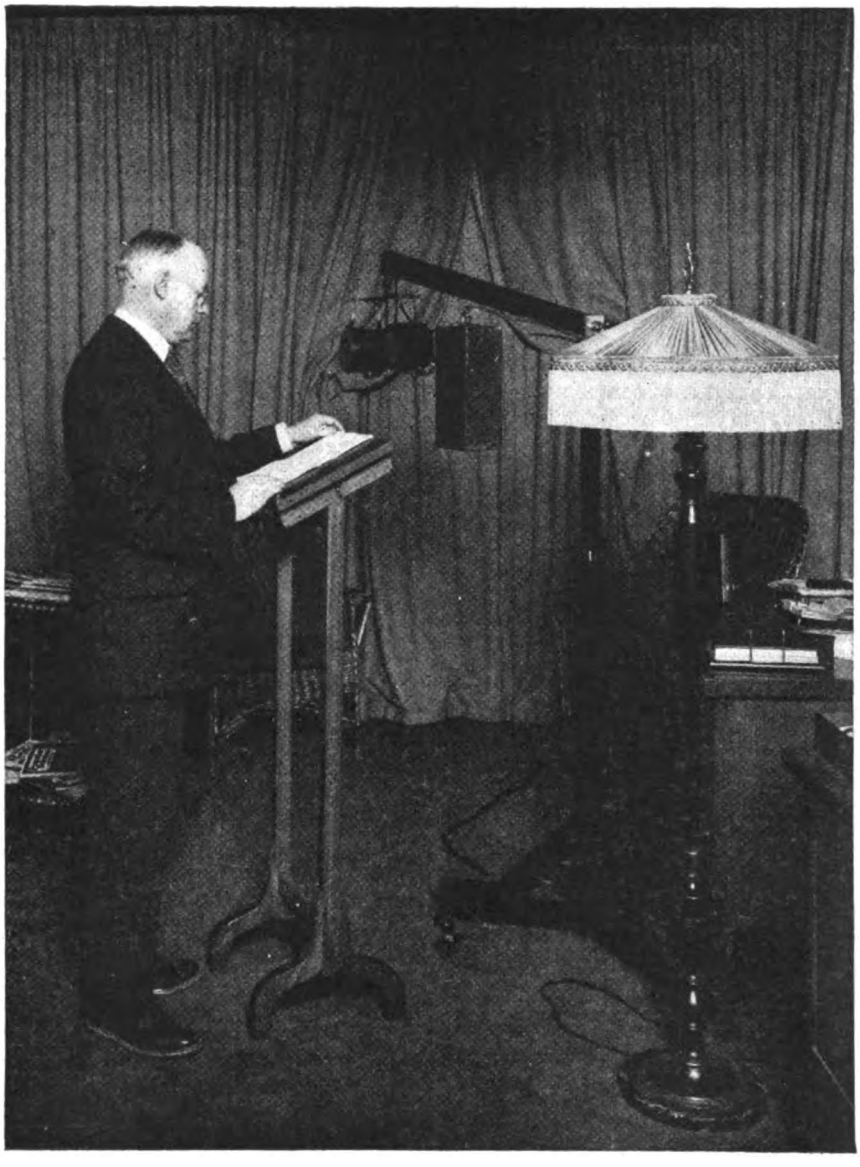
not yet reached the point where they are willing to give formal credit toward a degree to those who have obtained their instruction *via* the ether waves. In a number of instances they grant a certificate or diploma to those who can pass examinations satisfactorily or by other written work show that thay have faithfully absorbed the material offered them but as a rule these diplomas do not mean very much. However, the College of Applied Science of the University of Iowa gives the same formal credit to those who complete "air courses" which is received by other extension students whose study is done by mail. One hundred radio listeners have already been granted such credit, after completing courses to the satisfaction of the instructors. The University reports that of those who enroll for radio instruction a larger percentage complete their work than is true of correspondence students.

What subjects are being given at present by radio? While nearly everything in the ordinary college curriculum has been tried in one place or another, the most popular courses fall into three main divisions. First come general cultural subjects—languages, literature, social science, history, philosophy, current events. The field of women's interests is the next great division: household arts, cooking, home decoration, dress, the care of children. Finally come courses of a semi-technical nature for men, particularly in agricultural subjects: the care of crops, animal husbandry, or even, for city and suburban listeners, how to plant and tend a garden.

Courses in foreign languages, especially in French and Spanish, are among the most popular, despite the fact that these subjects are among the least suitable for radio presentation, as listening to the student's efforts and correcting his errors of pronunciation and grammar is such an important part of language teaching. New York University, which has been a pioneer in this field and has broadcast a complete "Air College," first through WJZ and more recently through WOR, reports that philosophy seems to have been the subject of widest general interest. Other courses of wide appeal are geology, psychology, English and social science. WCCO, the Washburn Crosby station at Minneapolis, finds its best items, aside from technical courses for farmers, are political science, language and literature. WGN, the Chicago Tribune station, broadcasts, among other things, piano lessons, English and Spanish. Approximately 1,000 students enroll for each course. Westinghouse station WBZ, Springfield, Mass., finds in common with others that critical courses in artistic, musical and literary subjects—



The Largest Classroom in the World

Up to the time that radio broadcasting became established the sound of the instructor's voice was confined within four walls and limited to students within prescribed ages. Today his voice may reach millions—of all ages and conditions. What effect will this modern range have upon our conception of the term "education?" (The above picture shows Prof. F. L. Bishop of the University of Pittsburgh broadcasting a series of science lectures from KDKA.)

music appreciation, dramatic criticism, short story writing, and the like, are well received. A number of stations broadcast book reviews regularly, and find this one of their most important features. Columbia University, which has experimented widely with courses in many subjects, broadcasting through WEAF, is at present emphasizing rather practical courses for women: child health, interior decoration, cooking and domestic science in general. The lectures on health which are broadcast from numerous stations at the present time should properly be called educational, using the term in its broader sense. So too should the lectures on current events by such men as H. V. Kaltenborn of New York City, which, while not given under the auspices of any educational institution, do serve a most useful function in enlightening the listeners as to what is going on in the world.

Broadcasting by colleges, while it is perhaps the best known educational aspect of radio, is in reality but a small part of the total activity in that field. Another great enterprise at present is that of the United States Government. While several governmental departments or bureaus are using the air to some extent, the most complete and serious effort is that of the Department of Agriculture, addressed to farmers. The Department made a brief experi-

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ment in broadcasting in the spring of 1926; and it was so successful that at present a very ambitious program is under way. Government experts have prepared an elaborate series of courses, and these are mailed out in mimeographed form to the radio stations, where announcers read them over the air. They are offered exclusively to one radio station in each district, so that there is no overlapping except, perhaps, for receivers with exceptionally long range. While a station is not required to take all of the courses offered by the Department, it is of course understood that any material requested will be broadcast. Once a series is started, there is no danger of its being dropped before its completion, for the listeners would undoubtedly make an effective protest if such a thing were tried.

Among the features which the Department of Agriculture is offering is a daily talk by "Aunt Sammy," who gives informal but decidedly informative talks to women on dress, food and similar domestic topics. She answers questions, suggests menus, and provides quantities of household hints of every description.

There is also the "United States Radio Farm School," which gives information to the farmer. (In fact, such a multiplicity of advice to the farmer is on the air nowadays that any agriculturist who owns a radio set has small excuse for not doing his job in expert style!) The Radio Farm School is offering twenty-four courses, of eight lessons each, in livestock, poultry culture and dairy farming. These are accompanied by printed lesson sheets, and bulletins on specific subjects.

Five days a week there is a "Noon Farm Flash" of fifteen minutes. This is a dialogue, supposed to be a telephone conversation between a farmer and a county agent. In these, current farm problems are brought up and advice given regarding them.

"Letters to Dad" is another lively series. A farmer's son, away at agricultural school, supposedly writes home telling his father of the new ideas in scientific agriculture which he is acquiring. There are also courses in agricultural economics, and "The Autobiographies of Infamous Bugs and Insects" are given so that the farmer may know how to fight these pests which in the United States alone destroy, every year, crops representing the labor of one million men.

An effort is made to have farmers enroll as regular students in the Radio Farm School, and those who complete the course satisfactorily are given formal certificates to that effect. Up to September 15, more than 500,000 requests for enrollment cards had been received by the Department.

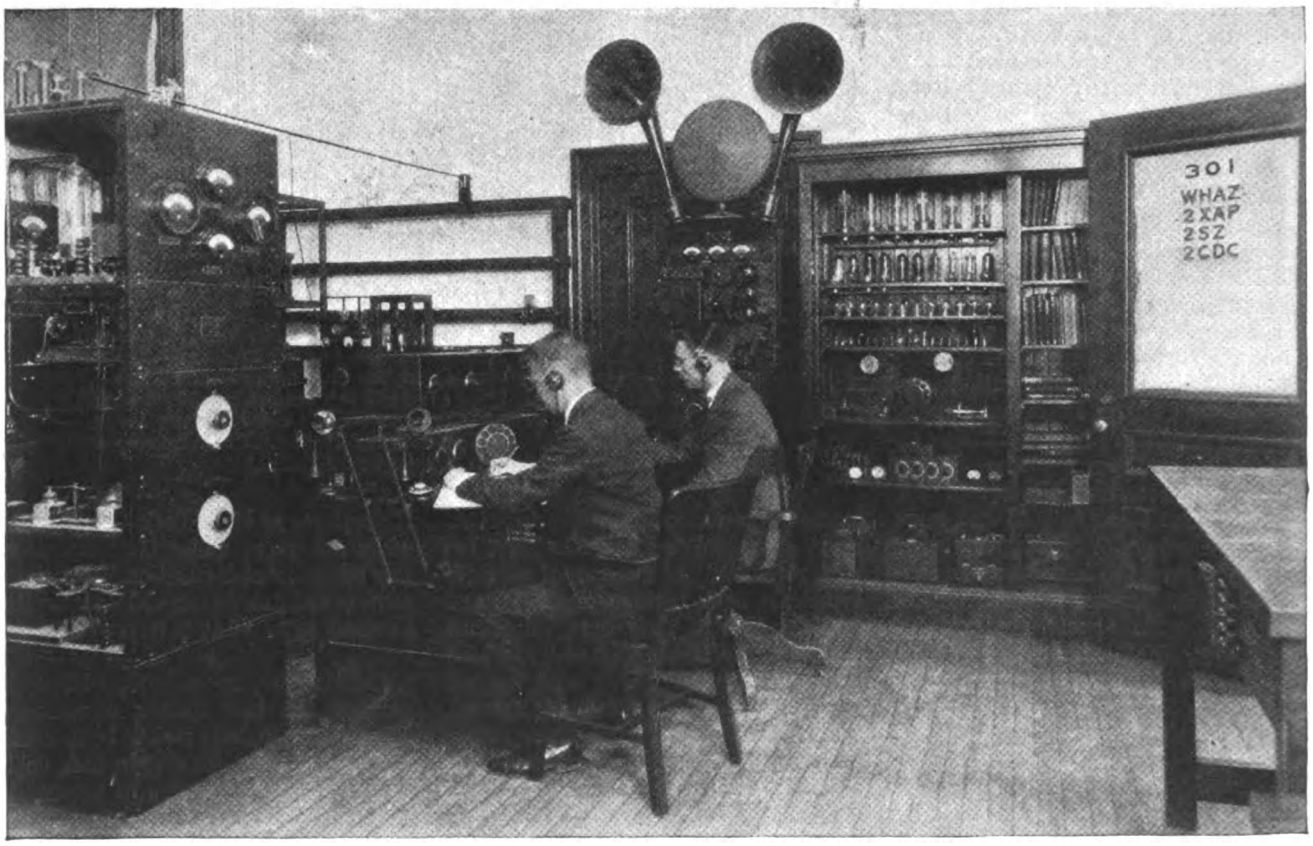
Thus far I have discussed only the use of the radio in educating adults. I need hardly say that it has enormous potentialities also as an adjunct to the regular public and private schools. These potentialities are only just beginning to be explored, but the success already achieved shows what lies ahead.

In several cities, notably in Atlanta, Ga., the radio is being used regularly as a means of instruction. Every school is fitted with a good receiving set and loud speaker, and on a carefully worked out schedule, instruction in various subjects is broadcast from a central station. The arguments used in favor of this work in the schools of Berkeley, Calif., apply as well to Atlanta and all other communities. They are:

(1) All the students have the advantage of instruction by the one best teacher in the city in each subject.

(2) The other teachers also have the opportunity to hear the work done by

(*Continued on page 168*)



One of the Stations that Are Owned and Operated by Colleges

The Rensselaer Polytechnic Institute of Troy, New York, is one of the scores of educational institutions that owns and operates broadcast stations, not only for the purpose of extending its educational scope but incidentally for the instruction of its students in scientific and mechanical equipment of the plant and in the experimental laboratory.

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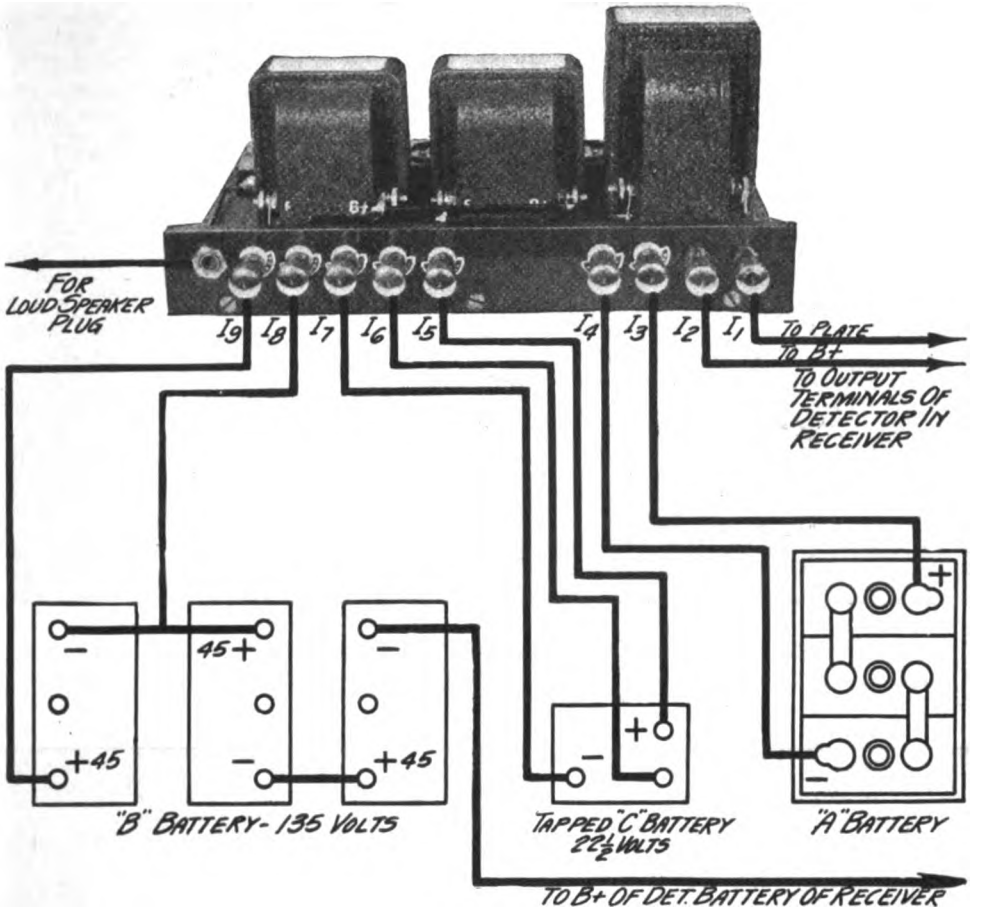

HOW TO CONNECT UP THE AMPLIFIER

FIGURE 1: *This picture hook-up shows how the audio-frequency amplifier that is described in this article is connected to the batteries, the loudspeaker and the receiving set.*

HOW TO GET QUALITY

AMPLIFICATION

NUMBER 1: *How to Build a Combination Transformer and Impedance-Coupled Audio-frequency Amplifier*

The first of a new series of constructional articles that will describe in detail the modern methods of amplification at low frequencies for obtaining quality reproduction. These amplifier units are small, compact and easy to build, so that they may be inserted either in an old receiver or in a new one in order to obtain undistorted low-frequency amplification.

By LAURENCE M. COCKADAY

COST OF PARTS: *Not more than $29.00*

HERE ARE THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS UNIT—

A—Rauland-Lyric audio transformer;
B—Rauland-Trio, type R-300;
C—Rauland-Trio, type R-310;
D1, D2 and D3—any approved vacuum-tube socket (Remler type 50 sockets illustrated);
E1 and E2—any approved automatic filament control, ½-ampere size (Elkay controls illustrated);
F—baseboard, 6 by 10 by ½-inch;
G—bakelite binding-post strip, 1½ by 10 by ¼-inch;
H—any approved open-circuit jack (Carter short jack, No. 1 illustrated);
I1, I2, I3, I4, I5, I6, I7, I8 and I9—any approved binding post (X-L binding posts illustrated);
Connection wires, screws, etc.

HERE is an audio-frequency amplifier that is designed to give great volume with clear quality as well as good high and low-note reproduction when used with a good loudspeaker. Compact and easily put together, it consists of a single stage of high-quality transformer-coupled amplification with two stages of impedance-coupled amplification.

This amplifier may be incorporated in place of the unit used in an old style receiver to bring the quality "up to date," or it may be used in connection with a new model that the home set-builder is experimenting with. It was designed especially for this purpose by the engineering staff of POPULAR RADIO LABORATORY and it has been found to give exceptionally good results when

(*Continued on page 174*)

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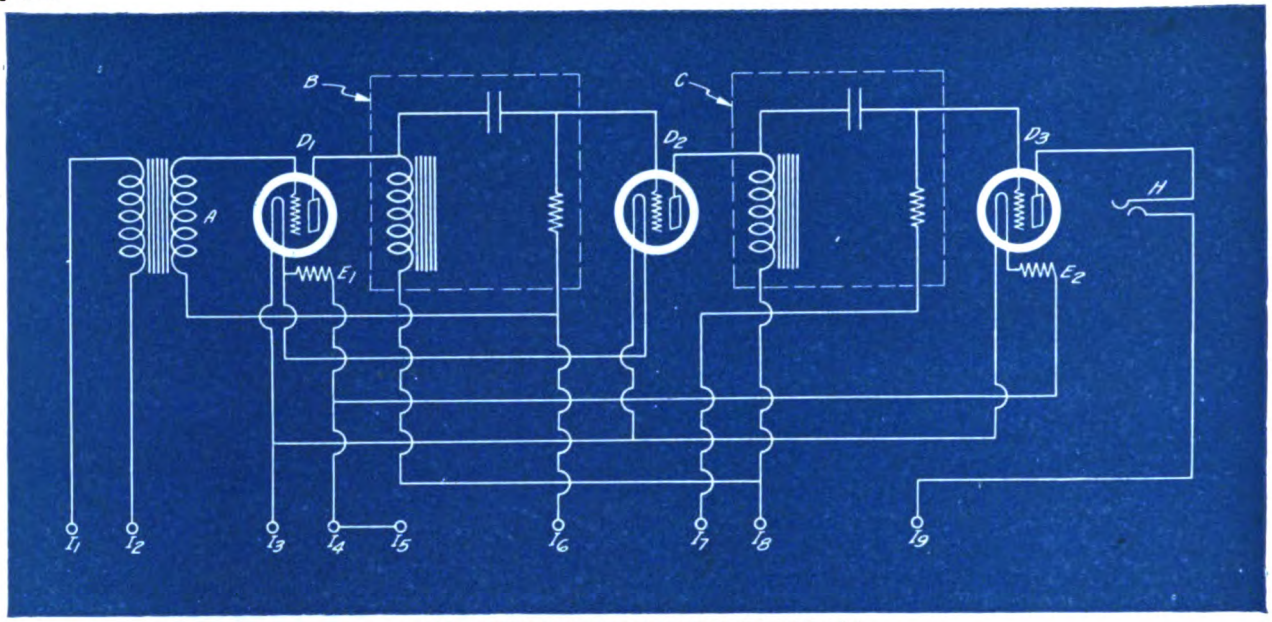
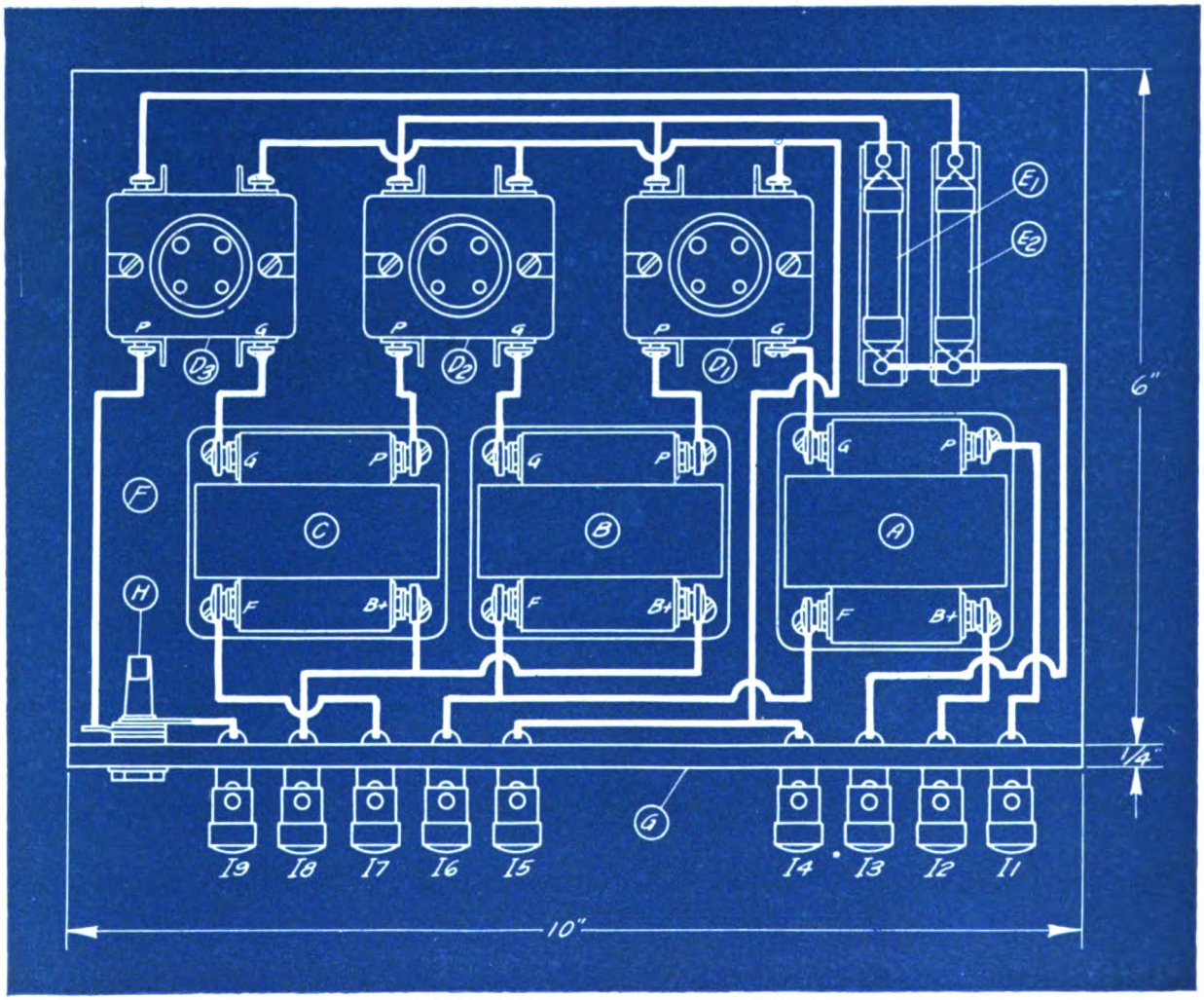


THE SCHEMATIC WIRING DIAGRAM

FIGURE 2: *This drawing gives the electrical circuit for the new amplifier; it comprises one stage of high quality transformer amplification and two stages of special impedance-coupled low-frequency amplification.*



THE PICTURE WIRING DIAGRAM

FIGURE 3: *This drawing shows the arrangement of the units on the baseboard and the manner in which they are connected; the wiring is shown in heavy white lines. All of the parts are marked with designating letters that correspond with the letters given in the list of parts and in the accompanying text.*

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A Station *that* Weighs 5½ Pounds

An extraordinary transmitter made by the Marines at a cost of only $22.00

By ANDREW R. BOONE

"DIT, dit, dit . . . dah . . . dah . . . dit . . ."

A Marine aviator, 5,000 feet above the Pacific, works his transmitting key.

One hundred and fifty miles away a second aviator listens.

Through the night comes the message: "dit, dit, dit . . . dah . . . dah . . . dit . . ."

One of the smallest practical radio transmitting sets in the world, constructed by Capt. Francis E. Pierce and other marine officers and enlisted men, is in operation.

This latest contribution to radio communication consists of a set built from parts culled from the navy's scrap heap at North Island and put together by skilled hands; $22.00 is the cost of the transmitter, and that came from the pockets of officers and enlisted men.

This little transmitter weighs only five and one-half pounds. It measures about the size of a typewriter, but it weighs far less. It is 9 inches wide, 9½ inches deep and 10 inches from front to rear.

With a sending radius of about 300 miles, the new transmitter, in the opinion of officers who built it, will revolutionize radio code transmission and reception to and from airplanes. It will take the place of sets few of which weigh less than 125 pounds. The set—including transmitter, receiver, antenna, batteries and dash control—weighs exactly seventeen and one-quarter pounds!

On fifty flights made by Capt. Pierce and other Marine officers at San Diego, the set worked "perfectly" forty-seven times: three times reception failed; but the failures are attributed to factors outside the set itself.

Two "fine points" are found in the set which make for its excellence: a high-frequency oscillator controlled by a one-inch-square quartz crystal, ground for a frequency of 3000-4000 kilocycles. With this crystal, a steady, high-frequency oscillation can be maintained. This is in contra-distinction to the former experience of aviators, who have generally had unsatisfactory results with a swinging antenna.

Andrew R. Boone

Radio's Latest Contribution to Military Aeronautics

This tiny but very practical little transmitting station has a sending radius of 300 miles; it was built by Capt. Francis E. Pierce of the Marine Corps from "the navy's scrap heap." With batteries, antenna, receiver and full equipment, it weighs 17¼ pounds.

The transmitter is constructed of aluminum sheet material and angles; the front panel measures 9 by 10 inches and the base 9 by 9½ inches. On the front panel is mounted the milliammeter for measuring the total current in the tuned-plate, "tank" circuit. The tiny base-panel contains the clips for the crystal, the grid-biasing resistance, the plate-blocking condenser, a socket for the 50-watt tube, the grid and plate chokes, the inductance for the plate circuit and the keying relay. The transmitter in action is swung by a shock-absorber cord that is suspended just beneath the aviator's cockpit.

Already the set serves for communication between Marine planes at San Diego and between planes and a radio-truck station, which also operates the 5½-pound transmitter. Two antennas serve the ground end of the station, one long and one short, for high and low frequencies. Each ground antenna extends from a pole 15 feet high to the truck chassis.

Power comes to the plane set from a wind-driven generator, mounted on the fusilage. The ground set derives its energy supply from storage batteries which are charged by a generator connected to a tiny gasoline motor.

The new transmitter is easily installed and dismounted, and it is effective over an area 600 miles in diameter.

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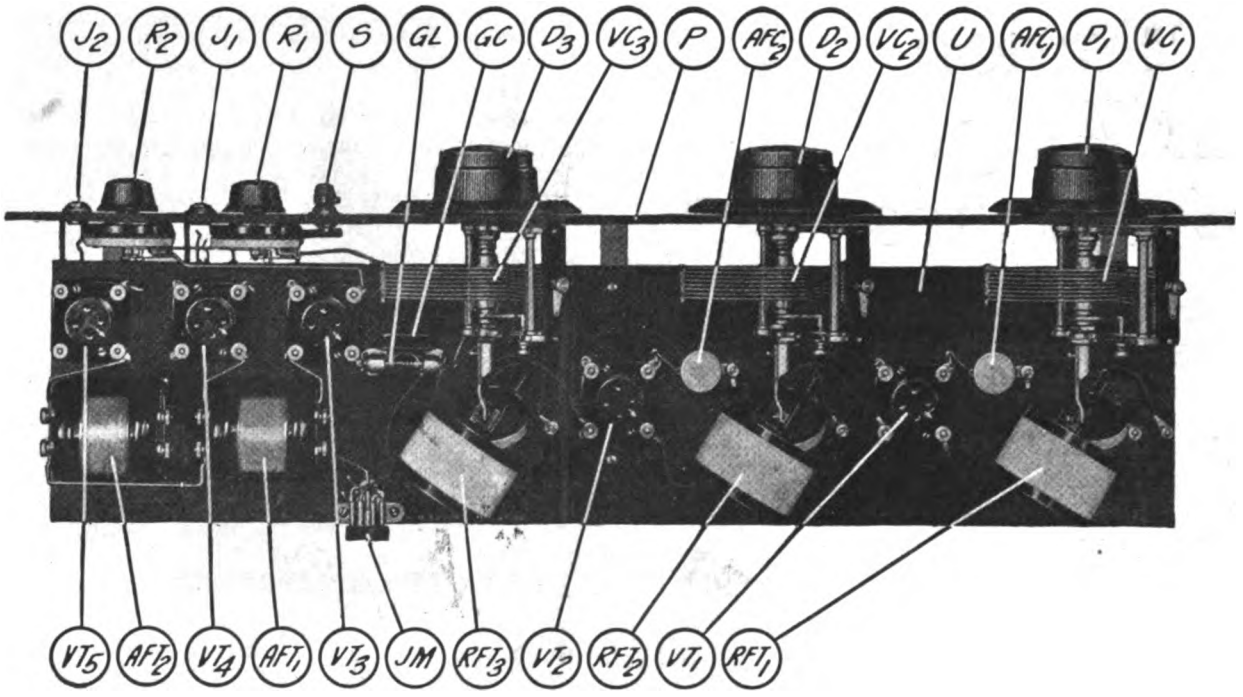


The Karas "Equamatic" Receiver

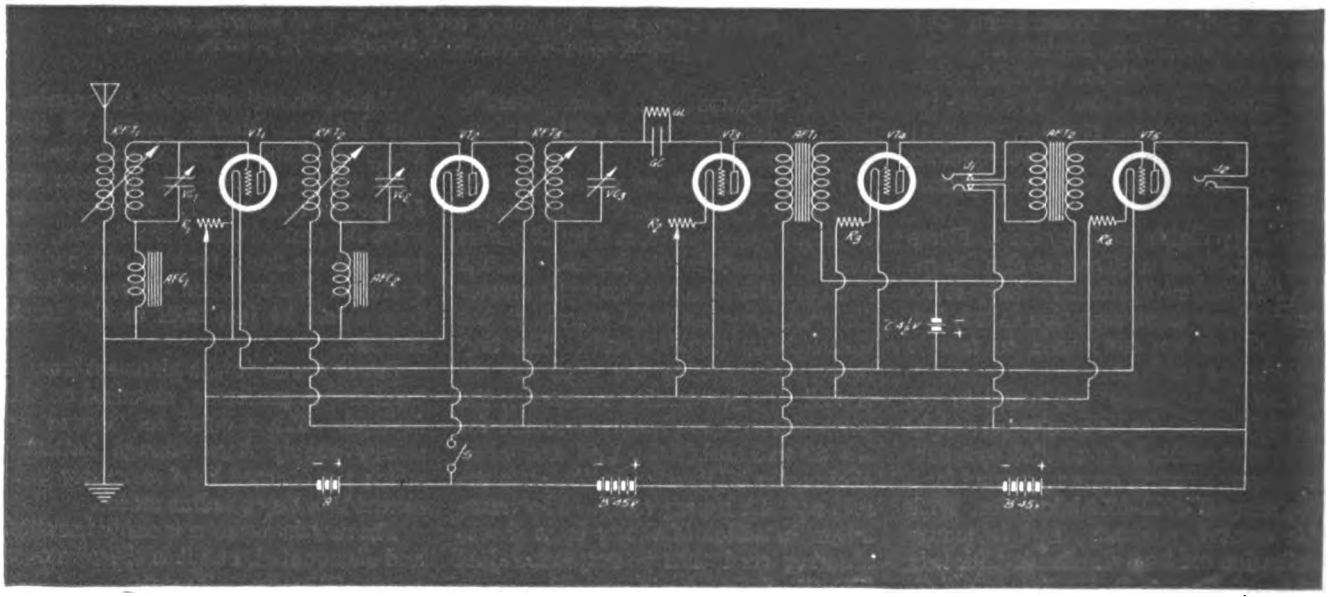
It is well known that the tendency to oscillate on the lower wavelengths is due to too much coupling between the primary and secondary coils of the radio-frequency stages. In the "Equamatic," the primary rotates in the secondary, and in such a manner that the circuit is kept just below the state of oscillation at all wavelengths. The efficiency of this receiver is thus kept at a maximum.

Popular Radio Circuits

INSTALLMENT NO. 7

THE PARTS THAT ARE RECOMMENDED FOR USE IN THIS RECEIVER ARE—

RFT1, RFT2 and RFT3—Karas Equamatic RF transformers;
AFT1 and AFT2—Karas Harmonik audio transformers;
VC1, VC2 and VC3—Karas Orthometric special extended shaft condensers, .00037 mfd.;
AFC1 and AFC2—Karas Equamatic retard coils;
VT1, VT2, VT3, VT4 and VT5—Benjamin UX-type tube sockets;
R1—Yaxley rheostat, with dial, 10 ohms;
R2—Yaxley rheostat, with dial, 20 ohms;
R3 and R4—Amperites, No. 1A, with mountings;
J1—Yaxley interstage jack, No. 4;
J2—Yaxley open-circuit jack, No. 1;
S—Yaxley filament switch;
GL—Amsco grid gate, 2 meg.;
GC—Sangamo grid condenser with grid-leak clips, .00025 mfd. capacity;
D1, D2 and D3—Karas micrometric vernier dials;
P—composition panel, 7 by 28 inches, drilled and engraved;
U—composition sub-panel, 6 by 27 inches, drilled;
JM—Jones multiplug with mounting, type BM;
3 Karas equamatic sub-panel brackets.



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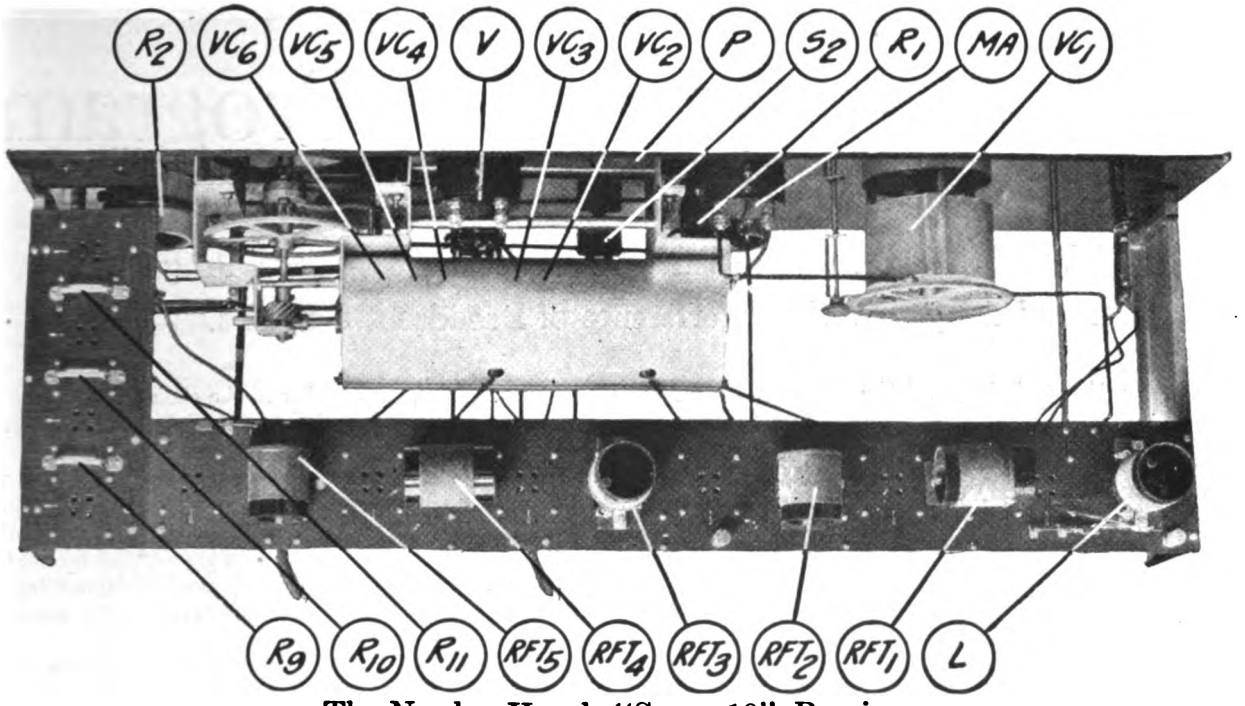
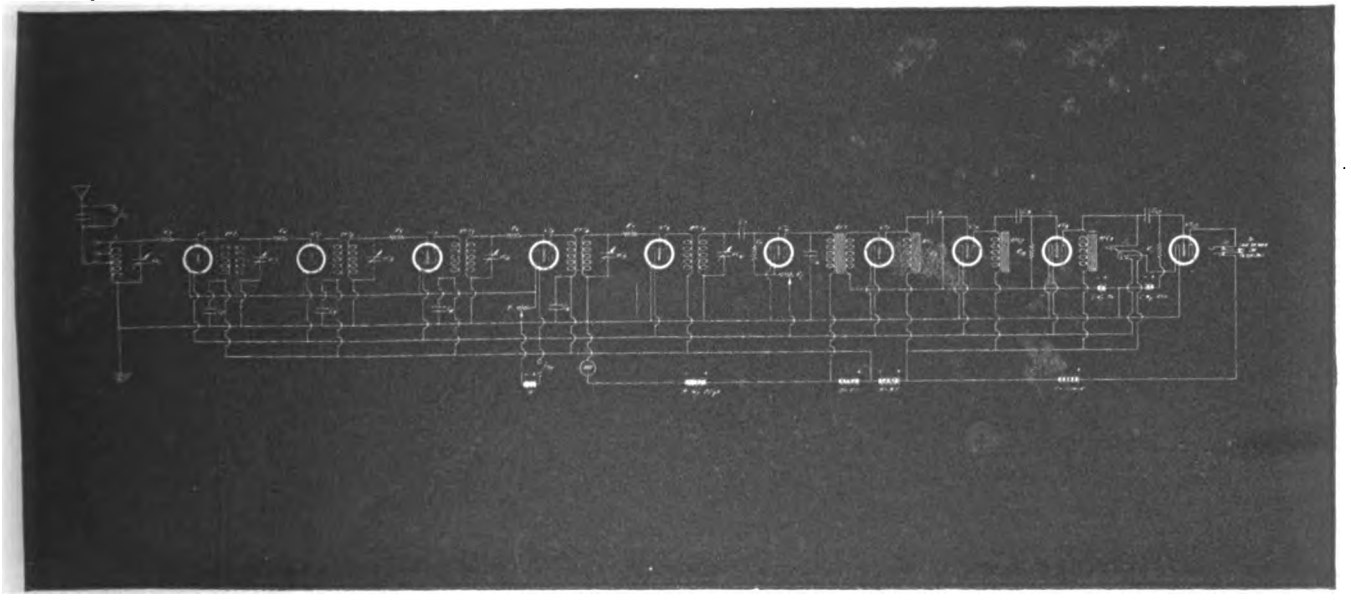


The Norden-Hauck "Super-10" Receiver

This set is a remarkable, straight radio-frequency receiver containing five stages of tuned radio-frequency amplification, a detector, one stage of transformer-coupled and three of impedance-coupled audio. The distance obtainable with such a radio-frequency amplifier should be sufficient to satisfy the most ambitious of set builders. Six tuned circuits are incorporated in the set but only two tuning controls are used. All tubes are of the UX-201-a type except the detector, which is a UX-200 type tube and the last audio-frequency tube.

The Parts that Are Recommended for Use in this Receiver Are—

L,RFT1, RFT2, RFT3, RFT4 and RFT5—Norden - Hauck radio - frequency transformers, type A;
AFT—Norden - Hauck audio - frequency transformer, ratio 6 to 1;
AFC1, AFC2 and AFC3—Norden-Hauck impedance-coupled units;
VC1—Norden-Hauck variable condenser, shielded;
VC2, VC3, VC4, VC5 and VC6—Norden-Hauck variable gang condenser, shielded;
C1—fixed mica condenser, .00025 mfd.;
C2, C3, C4 and C5—by-pass condensers, .5 mfd.;
C6—fixed mica by-pass condenser, .005 mfd.;
C7—fixed grid condenser, .00025 mfd.;
C8, C9 and C10—fixed mica blocking condensers, .5 mfd.;
R1 and R2—General Radio rheostats, type 214-a, 2 ohms;
R3, R4, R5, R6 and R7—Norden-Hauck type S-10 grid resistors, 750 ohms;
R8—metalized grid resistor, .2 meg.;
R9, R10 and R11—metalized grid resistors, 30,000 ohms;
VT1, VT2, VT3, VT4, VT5, VT6, VT7, VT8, VT9 and VT10—tube sockets, integral with base panels;
S1—Norden-Hauck selector switch;
S2—Cutler Hammer filament switch, type C-H No. 8008;
J1—Norden-Hauck single-circuit filament control jack;
J2—Norden-Hauck open-circuit jack;
MA—Weston milliammeter, type 301, scale zero to 50;
V—Weston voltmeter, type 301, double scale zero to 7.5 to 150;
P—bakelite panel, 36 by 9 by ¼-inch, drilled and engraved;
6 grid leak clips and spacers;
Gearing for gang condenser;
Brackets, posts for base panels;
2 General Radio vernier knobs, type 239;
Weston meter switch, for type 301 volt meter;
Cabinet, 36 by 9 by 10¼ inches;
Bus-bar, lugs, nuts, screws, etc;
2 General Radio knobs, type 137-D.



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THREE PRIZE-WINNING IDEAS FOR

Improving Broadcast Programs

1. "Stagger the Broadcast Programs."
2. "Each Station Should Identify Itself by a Specialized Program."
3. "Prevent by Law the Interference of Broadcast Stations."

Those, in the opinions of the judges, are the best answers received, in the prize letter contest conducted by POPULAR RADIO *to the question: "How Can Radio Broadcast Programs Be Improved?"*

AFTER several weeks of careful deliberation, the judges of the contest (announced in the September, 1926 issue of this magazine) have awarded the prizes to the following contestants:

FIRST PRIZE ($50.00) to William Andrew Mackay, *Coytesville, N. J.*

SECOND PRIZE ($20.00) to Charles D. Isaacson, *care of Station WRNY, Roosevelt Hotel, New York.*

THIRD PRIZE ($10.00) to Harold Moore, *116 North Wadington Street, Marion, Indiana.*

In addition to the above, prizes of $5.00 each have been awarded to the following contestants:

H. P. Angus, *Box 247, Forest Park Station, Springfield, Mass.*

H. G. CISIN, *312 Webster Avenue, Brooklyn, N. Y.*

F. P. Pursell, *601 Prospect Avenue, Scranton, Pa.*

W. P. Miller, *1161 Fifth Street, San Diego, California.*

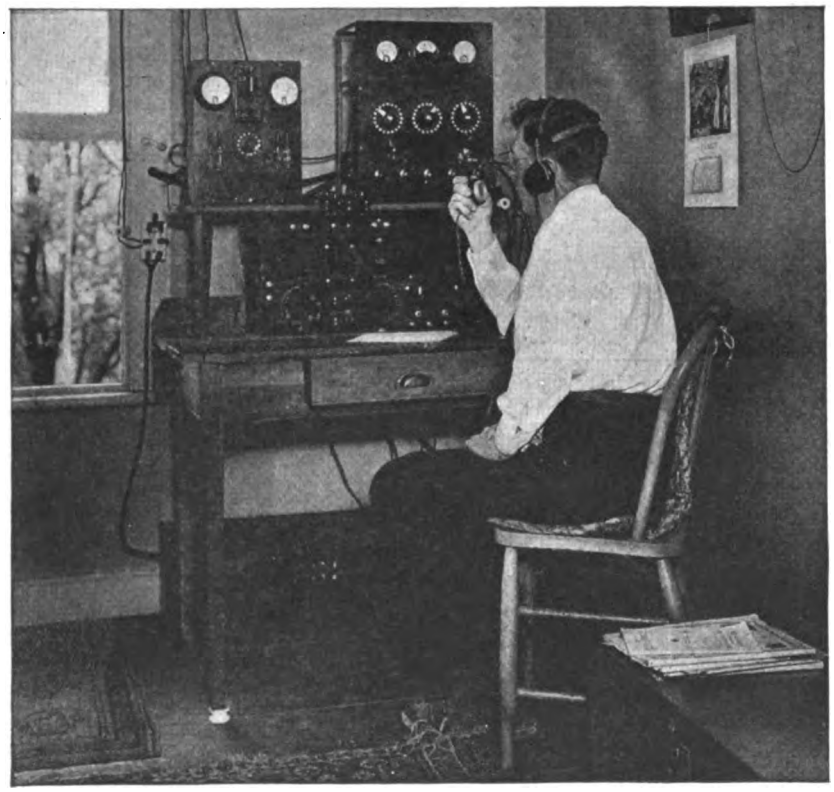
I. E. Morrison, *1772 Wilson Avenue, Chicago, Illinois.*

E. W. Vaill, *33 Seneca Place, Upper Montclair, N. J.*

The selection of the prize winners was no easy matter. Every one of the hundreds of suggestions was carefully considered, and the choice was finally narrowed down to sixteen of outstanding merit.

These surviving sixteen letters were re-submitted to every one of the judges who graded each letter on a percentage basis. The six letters that received the highest rating were again re-submitted for final selection—with the result announced above.

Many of the letters entered in the contest embodied good ideas; some of them were so original that reference will be made to them elsewhere in this magazine. The letters that won the three first prizes are printed in full herewith.



From a photograph made for POPULAR RADIO

The First Prize Winner—William A. Mackay, 2AQB

Old timers in radio will identify Mr. Mackay by his call letters which have become widely known to amateurs during the past few years. This picture was made in station 2AQB in Coytesville, N. J., owned and operated by Mr. Mackay.

"Stagger the Broadcast Programs"

(Winner of the first prize of $50.00)

By WILLIAM ANDREW MACKAY

THE trouble with broadcasting is simple to analyze; there is too much of one thing at a time.

The early hour of the evening is the lecture hour; the later hours are dance hours. All stations are alike.

What malign fate is it that persuades every single station in our city, or in any city, to put on exactly the same kind of program at exactly the same minute each night?

Yes it is so easy to do something about it. All that the stations need to do is to stagger the programs; one kind of program at one hour, another kind at another hour. Never the same kind of program at the same hour for any two near-by stations at the same time.

There are six stations that my wife and I can hear conveniently on our radio set. There are also six hours in the usual radio evening, from 6:00 P.M. until midnight. If I owned those six stations what I would do with their programs is represented on the accompanying "program diagram."

Let station Number One fill up its evening with an hour-by-hour program which has now become (alas!) virtually the standard thing for all stations.

Between 6:00 and 7:00 we will have an orchestra playing classic selections, tempered, perhaps by a trace of the "popular"; this is now what appears as "dinner music" on so many stations' programs.

For the next hour, 7:00 to 8:00, we will allow the professors to talk, just as they do now. Preferably there should be four or five of them during the hour, for there are few speakers who cannot exhaust practically everything really interesting that they know in fifteen minutes or less.

(Continued on page 180)

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¶ "Trouble-shooting," as well as the testing of tubes and checking the operating conditions of a receiver, are made easy by the use of this simple test unit

From a photograph made for POPULAR RADIO

THE AUTHOR TESTS A RECEIVER WITH THE NEW DEVICE

FIGURE 1: *This instrument, which may be assembled at home at a cost for parts of not more than $22.00 makes it possible for the set-owner to locate and repair trouble in his receiver without guess work.*

HOW TO BUILD AND USE

A PORTABLE TEST-BOARD

By ALBERT G. CRAIG

HERE ARE THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS UNIT—

C—connection plug (UX-201-a tube base);
V—any approved voltmeter, range zero to 8 volts (Weston, model 301 illustrated);
MA—any approved milliamperes, range zero to 25 milliamperes (Weston model 301 illustrated);
VT—any approved UX-type socket (Benjamin Cle-ra-tone socket illustrated);
S1 and S2—Muter double-pole, double-throw knife switches, stock No. 2020;
S3—Muter single-pole, double-throw knife switch, Stock No. 2010;
T—composition panel, 7 by 14 inches;
U1 and U2—hardwood supports for panel, 2 by 7 by ½-inch;
4 binding posts, any approved type (Eby binding posts illustrated).

HERE is a portable test unit that has been especially designed to fit the needs of the experimenter who wants a handy test board that may be used to check the operating conditions of a receiver, to determine the characteristics of vacuum tubes and for general trouble-shooting.

The unit is simple to build and simple to operate.

The test board consists mainly of a connection plug for insertion in any of the tube sockets in the set, a socket on the test board in which the tube which is replaced by the connection plug may be inserted for test and a four-wire cable connecting these two. A filament voltmeter with a reversing switch and a plate milliammeter are connected in the circuit on the test board.

The two principal connections on the board may be changed at will by switches. The first of these is for determining the operating conditions of tubes as used in the radio set and for locating trouble. The second may be used to determine the operating characteristics of the vacuum tube itself.

How to Use the Test Board to Examine the Operating Conditions of Tubes in the Receiver

Remove one tube from the radio set under test and place it in the socket, VT, of the test board. Next, insert the connection plug, C, in the empty socket of the radio set.

Then, set the voltmeter reversing switch, S1, so that the filament voltmeter reads in the right direction. Set the other double-pole, double-throw switch, S2, so that the plate and grid wires of the connection plug go direct

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to the socket, VT, of the test board.

The tube on the test board is now operating under the same direct current voltage and plate condition as when it is used normally in the radio set. The filament voltage and the plate current of the tube under test should now be observed and should approximate the tube manufacturer's specifications.

The specifications for all standard types of tubes are given in the table on page 146.

It may be noted that the specifications in this table are made up for zero resistance in the plate circuit of the tube, while the tube in the radio set will ordinarily be operated with some piece of apparatus in the plate circuit, which may have considerable resistance, such as an audio-frequency transformer or a plate-coupling resistor. Therefore, the "B" voltage supplied may have to be considerably higher than the table rating to produce normal plate current.

How to Use the Test Board for Tube Testing

The voltmeter reversing switch, S1, need not be changed in order to test the tube. The other switch, S2, should be thrown over in the opposite direction. The links should be left across the "C" battery and "B" battery binding posts.

The filament wires run direct from the connection plug to the filament of the tube on the test board as before. The grid wire from the socket, VT, on the test board may now be connected through switch S3 to either side of the filament of the tube thus changing the grid-bias by the same amount as the reading of the filament voltmeter, V. The plate wire runs from the connection plug to the plate of the tube on the test board as before.

There will normally be some piece of apparatus in the plate circuit of the tube now and it is advisable to keep the resistance of this instrument as low as possible for tube testing.

One suggestion would be to make the test in a radio-frequency socket as the DC resistance of the radio-frequency transformer is usually low. Another suggestion would be to make the test in a socket that has a jack in the plate circuit of the tube and to insert a short-circuited plug in this jack.

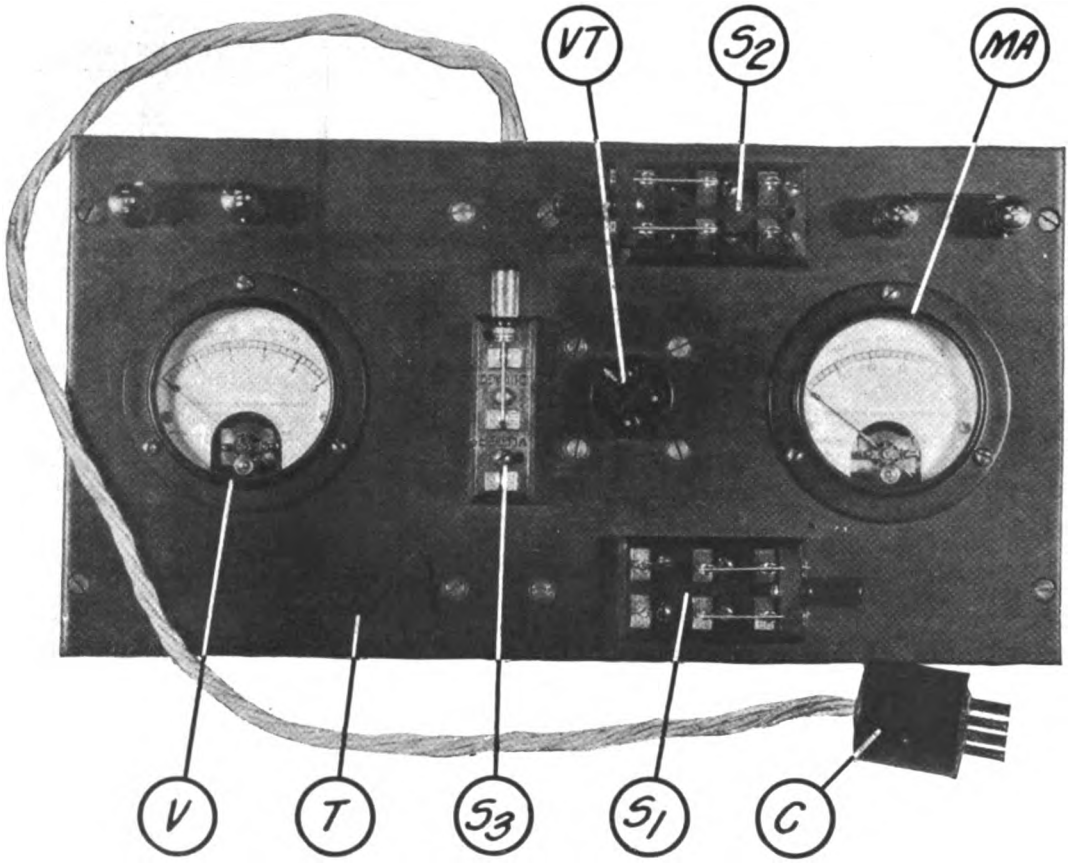
For a given plate voltage, the plate current may now be taken as a measure of the plate resistance of the tube under test; and, if the plate current is normal, the change in plate current by reversing switch S3 (changing the grid-bias) may be taken as a measure of the amplification factor of the tube under test.

A few observations on the behavior of good, standard tubes under these tests will aid noticeably in judging other tubes.

The "C" battery binding posts, 1 and 2, are to be used for inserting the proper "C" battery when testing tubes that require a grid bias as large as 22½ or 45 volts. The "B" battery binding posts, 3 and 4, are not for the purpose of inserting additional "B" battery voltage, but it was intended that the link might be removed and a flexible lead run from binding post 3 to any desired voltage tap of the receiver "B" battery. Binding post 4 is then left unconnected.

An example of the use of this flexible lead in measuring tube characteristics may be given. Switch S3 was set on the negative filament connection. Binding post 3 was connected to the 67½-volt "B" battery tap and the reading of plate current meter MA, was 4 milliamperes. Binding post 3 was next connected to 112½-volt tap of the "B" battery and the reading of MA was 10.1 milliamperes. The change in plate current per volt of "B" battery change

(*Continued on page 164*)



HOW THE TEST BOARD LOOKS FROM ABOVE

FIGURE 2: *Two meters are mounted directly on the panel with three switches, tube sockets and the binding posts in easily accessible positions. The extension cord is fastened to the terminals beneath the test board and they extend to the connection plug made out of the base of a burnt-out vacuum tube.*

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Is Radio Broadcasting Killing the Wild Savageries of JAZZ?

By EARL REEVES

GENTLEMEN of superior intellects lately have had a habit of referring to the rest of us as "jazz hounds." Moreover, they study the job-lot of us through thick-lensed spectacles and refer to this era as "The Jazz Age."

They are not tossing us bouquets: it's brickbats they are throwing.

They go on and say we have low musical tastes; and that radio not only proves it but has contributed to our cultural downfall.

The only trouble with these wise fellows is that they are all wrong. They have not studied the available evidence.

The evidence decidedly is in our favor. We have discovered with some amazement that we *like* good music—and that jazz does not wear well.

As regards the blare-blare of jazz and the sticky-sweet fluff-stuff that is produced along Tin Pan Alley we are somewhat like the boy who went to the country to visit his grandmother. He was continually getting into the sugar, so she took him to the pantry, showed him the sugar-barrel and invited him to eat all of its contents if he wished. When she asked him later whether he had eaten it all he said he had eaten "all of it that was good."

When we had a jazz hunger—while the craze was at its height—radio crashed through and gave us a chance to have all the jazz we wanted.

And we've had about as much of it as was good.

But I must not fall into the error of which the learned professors are guilty; I must not generalize without citing the evidence.

Mr. Charles B. Popenoe comes very near being an authority. He built the first permanent broadcasting station and was director of broadcasting for the Radio Corporation of America.

"Less than ten percent of our public want jazz," he told me. "We therefore decided to keep it off the air until very late at night."

Mr. Popenoe explained that his statement was not a guess, but was based on a careful study. He added:

"The telephone people, while operating WEAF, discovered that less than five percent of that station's audience wanted jazz."

This survey amazed the officials who made it, Mr. C. F. McClelland (now general manager of the National Broadcasting Co.) admits.

"More important than the percentage itself," he said, "is the great change in taste which it shows over a period of two or three years."

Here also I found another striking bit of evidence. Picture the managers of this great station making a first timid experiment at putting grand opera on the air. A station which was a quarter of a million dollar a year experiment, testing out on the millions of us who cannot indulge in luxury, the music usually sung for the "diamond horseshoe" of the

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Metropolitan Opera House. The men who are hid from us, far behind the microphone, building programs, smiled at each other over their first tiny "grand opera troupe." Sometimes they referred to the singers as "the long haired gang"; or would say, perhaps, "Bring on the high-brows." They thought it rather a presumption that they should be meddling with grand opera: they were rather sheepish about it: what in the world would *we* think of them?

The millions of listeners have changed the views of station managers regarding this troupe. It is nothing to be apologetic about: it is a very important and popular group of singers. Grand opera by radio has become so important, in fact, that expert musicians are employed regularly now to "cut" operas from their full stage size score to a length suitable for entertainment in our living rooms.

Cutting grand opera to radio studio proportions is a brand new profession. To me, that is a very striking fact.

In a sense, the two stations mentioned are endowed institutions. They are maintained by the biggest unit in the radio world as a service to set purchasers and as indirect advertising.

The advertiser who walks up to the radio broadcast counter and lays down hard cash for time on the air in order to win friends for his product must have a very hard-boiled measure of what we like. Or he should have. To mention two prominent "radio advertisers:"

The Silvertown Orchestra began entertaining us with dance music only and worked from that to the briefing of musical comedies:

The National Carbon Company started its "goodwill advertising campaign" with the jazziest of "blues" and with minstrel shows, and later paid out many thousands to give us musical comedy and light opera—believing that giving us such musical diet pays.

In a sense, the story thus far concerns the metropolitan districts, although these big stations reach across the country, directly or in tie-ups.

But what of stations actually located in the west?

Louis J. Johnen gave me a report on station WLW (the Crosley station in Cincinnati).

"Most of our programs," he said, "are what may be termed popularly classical; that is, they consist of the more or less familiar classics.

"As far as abstruse music is concerned I can assure you that it is little to the taste of the radio audience."

"On the other hand," Johnen said, "Jazz, though it has its few devotees, is not so popular as is commonly supposed."

Station WLS, owned by the Sears-Roebuck Agricultural Foundation, reaches still farther into the territory where men are men.

Although previously convinced that the farmers of the country preferred "popular" music, WLS several months ago tried out a symphony orchestra series with amazingly favorable response. On opening night the "Blue Danube Waltz" alone brought in fifty letters.

This station still experiments, tabulating mail, cross indexing it, and "measuring" its public; and I have what might be called an "ad interim" report, as follows:

"Our evidence indicates that a radio station, if it is going to be of the greatest service to the persons who pay for its operation, must run throughout the week at least 60 percent popular and 40 percent classical or semi-classical. But by popular music I do not mean entirely wild and screeching jazz continuously, but some jazz and in addition music that always is known to the general public."

I get somewhat similar signs from the station operated by the State College of Washington—which carries the case to the Pacific coast.

And I think the learned critics who refer to the millions of us as "jazz hounds" and deplore our musical taste accordingly, will have to admit that all this is a far cry from what they would have expected the figures to show.

There is one man well-known to you —Mr. A. Atwater Kent—who is very certain that radio is killing jazz and lifting our musical tastes to higher levels. When he wanted to remind us pleasantly that he builds radio sets he decided to give us the most famous opera singers.

"Our decision came about as the result of exhaustive inquiries," he explained.

"After our concerts had begun we received thousands of letters of appreciation. We addressed a questionnaire to a list of approximately six thousand of these commentators. The responses were most interesting and enlightening. Replies were received from 48 states and 569 cities and towns, covering both rural and metropolitan centers.

"Ninety-two percent expressed the view that there was not too much classical music. A slight majority, 56 percent, indicated the belief that there is too much jazz music broadcast."

Like President Coolidge, Mr. A. Atwater Kent was born in rock-ribbed Vermont; moreover, he built his business in conservative Philadelphia. Yet this double-dyed Yankee bet several hundred thousand dollars that he knew what we wanted—and that it was *not* jazz!

In Tin Pan Alley, whence comes jazz, radio is viewed with mixed feelings.

Managers of song factories who once tried to get a new song on the air to help advertise it are much more apt today to say: "For Heaven's sake, don't let 'em broadcast it."

To be sure, in rainy England splashing holiday crowds still trudge homeward chanting a promising that it ain't goin' to rain no mo', and the author of that bellowing refrain was made famous here at home by radio; nevertheless, the number of song-writers who have been "made" by radio is a very small percentage of the number who have been "unmade."

"The big hits are harder to find today," the manager of one of the leading music publishing houses said mournfully. "In the beginning we thought it was good advertising to broadcast a song. But we have found that the sentimental songs of the sort that have been big hits in the past can be killed by too constant radio repetition."

"Of course jazz and sentiment are still the best sellers—" this from a retailer—"but they are relatively less popular, sales have decreased; while the good old tried and familiar songs are selling better. These songs bear repetition: they never grow old. Radio has made them more popular."

One of the editors of a music magazine rounded out this picture of the tastes of all-of-us for me.

"I know of many composers who have quit writing songs because the jangles they are capable of writing no longer will go down with the public," he said. "Men who could collect fifteen or twenty thousand dollars a year royalties a few years ago have had to 'accept' positions as shoe clerks, soda dispensers, or collar salesmen."

From all of which I conclude that if radio is not killing jazz dead, it is at least reducing the popularity of the lighter-weight products of Tin Pan Alley—and proving to us that we like better music.

What Radio Is Doing to Sales of Jazz

"THROUGH *the medium of broadcasting the life or sale of popular sheet music has been considerably hampered. Every music publisher in the business will acknowledge that the sales of popular sheet music have fallen off considerably—and that radio is sorely to blame.*"

Paul A. Specht

DIRECTOR OF SPECHT'S ORCHESTRA

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THE SKELETON OF A MODERN STUDIO
The walls must be designed and constructed with the greatest care to prevent the least distortion in tone quality from entering the microphone. Here are shown the mass of wires, the drapery and the other elements that go into the making of the room from which the broadcasting is done.

The Fight Against DISTORTION

The ingenious tricks employed by radio engineers to deliver good broadcasting to your home

By RAYMOND F. GUY

THE fundamental problem and purpose of broadcasting is the transmission of vibrations of sound and of electricity. The broadcaster picks up sound vibrations, converts them into electrical ones and finally transmits them, in so far as possible, in exactly the same proportions as when they were first produced.

The sound vibrations range from approximately 30 to 15,000 per second; beyond these limits the average person cannot hear and the transmitting stations so far have been unable to transmit because of apparatus limitations. It has been found that a frequency band of from 50 to 7000 cycles is ample for obtaining excellent transmission; and that is approximately the band that is covered by the better grade of stations.

These vibrations of sound, during speech or music, change very rapidly in frequency and in amplitude. In the case of symphony orchestras, such as, for instance, the New York Philharmonic, the amplitude at one part of a selection may be 10,000 times as great as at another part.

Practically all single sources of sound have one fundamental frequency and several harmonics or overtones. It is these overtones which distinguish various sources of sound from each other, which make a violin sound like a violin and a flute like a flute.

A number of these wave shapes are shown in Figure 3 to illustrate this point. The difference in the number of harmonics and in their shapes is what distinguishes them from each other.

It is obvious that to obtain correct transmission the harmonics must be transmitted faithfully in their right proportion; and it is here that the difficulty arises. Needless to say, the transmission will be most natural and pleasing when there are no extraneous noises caused by obstreperous wire lines, noisy pick-up devices or by generator hums.

The first requirement is that the sound emitted at the source, whatever it may be, must reach the microphone in its original state. If the microphone is too far distant and if the hall or studio is not well designed acoustically, the original sound will be heard plus several echoes from the walls and ceiling and even from large objects of furniture.

It is interesting to note that the reason

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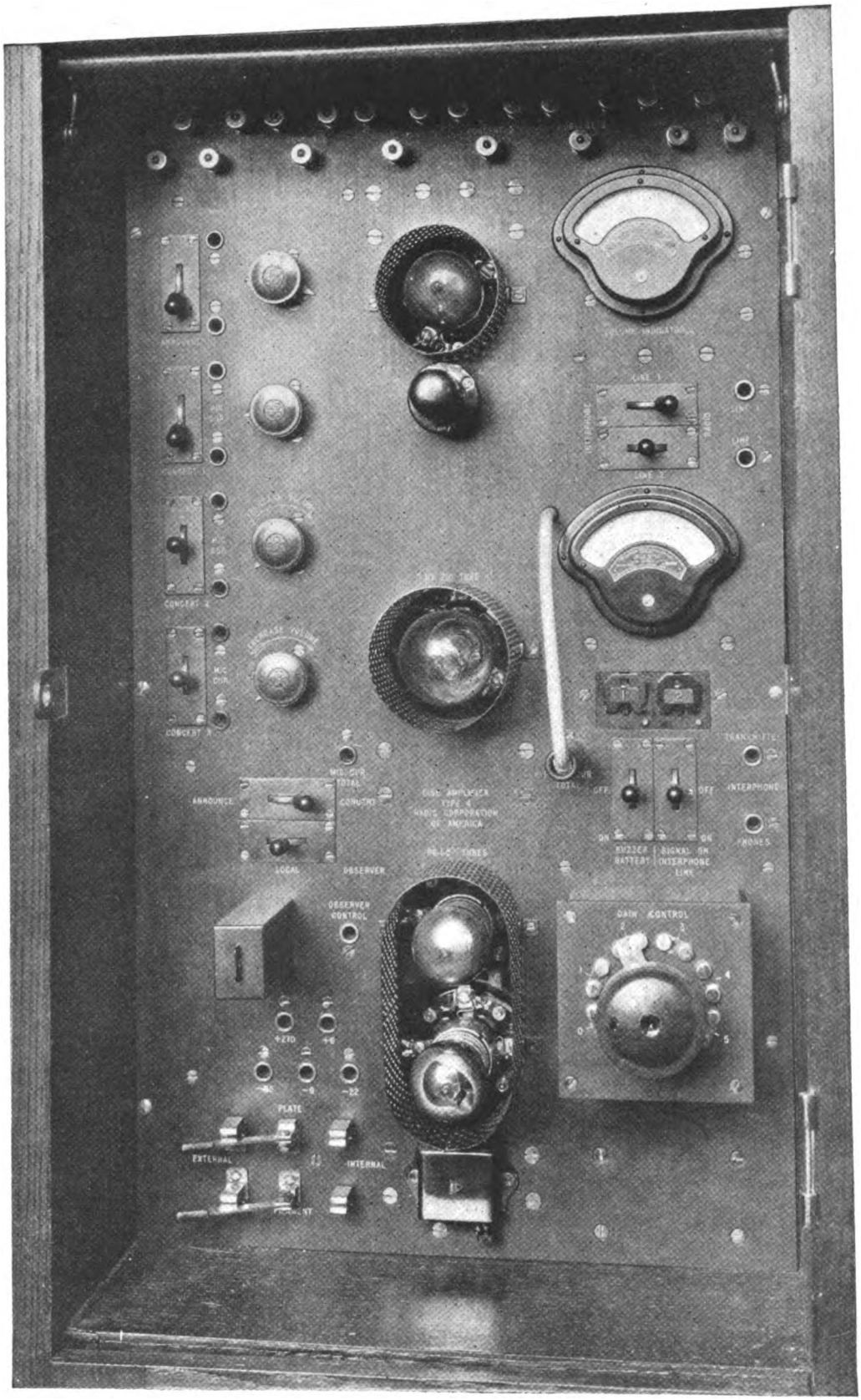

The Elaborate Control Board in the Broadcasting Station Where the Modulation Work Is Done

FIGURE 1: *The type of control board that is used to pick up programs. Means are provided for the operator to listen in while the currents are passing over the land wires to the station, so that he may check up on the reproduction and adjust the amplifier circuits to values that will make the reproduction as lifelike as possible. The legends printed on the panel fully explain what all of the instruments are for.*

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any sound such as the music from an orchestra in a large hall sounds "distant" is because there are echoes accompanying the original sound. Who has not heard an out-of-studio broadcast from an auditorium, for instance, such as the Republican Convention Hall in Cleveland, without picturing the size of the hall from the sound of the organ? Subconsciously one times the echo. This is in itself confusing, but, in addition, there is often a certain frequency at which a room is resonant, resulting in a "ringing." Anyone may verify this by whistling up and down the scale in some small room or enclosure and noting the predominance of certain pitches which will usually be quite pronounced.

Another possible factor is the reflection of sounds from the walls, floors or ceilings, which causes high and low sound pressure areas or nodes, which are known as "standing waves." These may be easily observed, if one has a strong single-frequency sound source in a comparatively bare room, by walking slowly toward or away from the source of sound. The nodes will be evidenced by the fact that the sound will be much more intense at various places than at others closer to the sound source. They usually occur at regularly spaced intervals.

To cure or to minimize these sources of distortion, the microphone is placed as close to the sound source as is consistent with good musical balance and freedom from overloading. This is a very simple remedy; and it is usually sufficient because the ratio of original sound to the echoes, as the microphone is moved closer, is much improved.

The surest method, however, is to treat the walls, floor and ceiling with acoustical absorbents such as a thick carpet on the floor and monks cloth or felt on the walls and ceiling. The best sound absorbents are open windows and close behind come audiences. Human beings absorb sound in more ways than one.

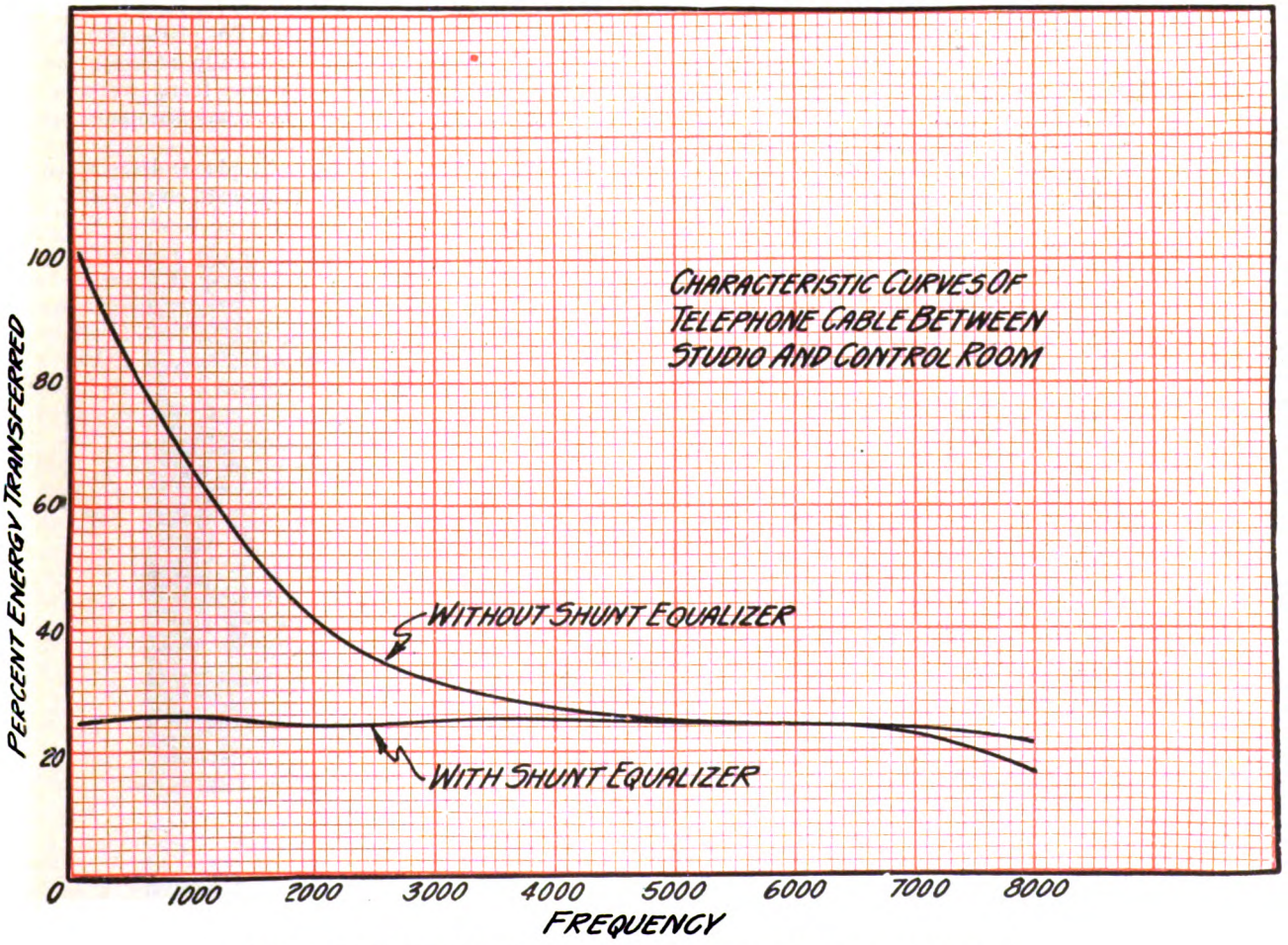
Monks cloth is not sufficient alone to dampen the walls unless it is used in excessive quantities. This is because low frequencies pass through it quite readily whereas frequencies of the order of 3000 cycles are fairly effectively absorbed.

It is reported that the studio walls of one New York station were originally carefully modeled of layers of thick felt, air and specially painted, sound transparent muslin at considerable expense, only to have the whole business spoiled by well-meaning but unknowing workmen who gave the muslin a coat of shellac, thus rendering the surface hard and making it a good sound reflector.

In some cases it would help to move the broadcasting from one part of a hall to another where the walls are irregular instead of flat, as the irregular walls would not reflect as much sound in any one direction. This method is not practicable and is rarely, if ever, used.

The next step the vibrations take is a change from sound to electricity in the "microphone."

There are three types of microphones in use in which the sound causes a change in resistance, in inductance or in capacity. These are known respectively as carbon, electrodynamic and condenser (or electrostatic) transmitters. The carbon and condenser types, and some forms of the electrodynamic transmitters, employ metallic diaphragms which, unless they are carefully dampened and stretched so that their resonance period is very high, cause an unnatural predominance of certain frequencies that result in distortion.



HOW A POOR TELEPHONE LINE MAY BE IMPROVED BY LOADING

FIGURE 2: *These curves show how a telephone line with an uneven transmission characteristic may be improved so that it will pass all frequencies with more uniformity.*

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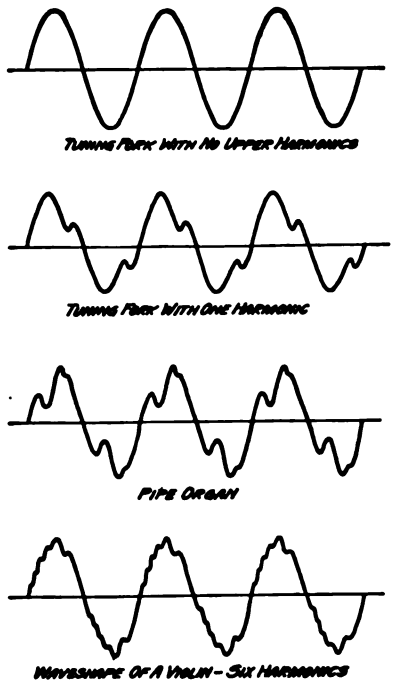
Condenser and carbon microphones have their diaphragms stretched to a natural period of approximately 6000 cycles.

Electrodynamic microphones often have low resonant periods, that is, below 50 cycles. These devices are often very sensitive to mechanical shock so that elaborate shock-proofing, and in some types, "doctoring" is required because of a frequency response characteristic which varies inversely as the frequency. Because of these difficulties and their low voltage output they are little used.

The most commonly used type of transmitter is the double-button carbon device which contains a light duralumin diaphragm .002 of an inch thick, which is so stretched and dampened that its frequency response curve is flat from about 100 to 6000 cycles. On each side of this diaphragm is a gold-plated area against which the carbon rests. The carbon is held in place by means of a felt ring separated .003 of an inch from the diaphragm; and, as the smallest carbon globules are about .005 of an inch in diameter, they stay in place.

As the sound waves strike the diaphragm they compress the carbon in one button and loosen it in the other, thereby changing its resistance. This is a pushpull device which minimizes distortion.

The most serious drawback to carbon devices is "blasting." When too violent impulses strike the diaphragm they cause it momentarily to leave the carbon, breaking the circuit and causing an annoying raspy sound. All carbon microphones have this disadvantage but it may be prevented by careful handling. Another disadvantage is the hiss produced by the carbon itself when current is passed through it.



HOW HARMONICS AFFECT WAVE FORMS

FIGURE 3: *This series of four curves shows how harmonics change the character of the sound without altering its pitch. In this case, the tuning fork, the pipe organ and the violin curves are shown with their accompanying harmonics.*

However, because of its simplicity, its ruggedness and its comparatively high output, the carbon microphone is used in practically all broadcast studios.

Another type of microphone which is used to a much more limited extent is the condenser type, which is similar to the carbon device with the exception that it has no carbon buttons.

A special backplate, in this type, forms one plate of a variable condenser, while the diaphragm is the other plate. The capacity and thus the voltage across its terminals when it is charged, is varied by sound waves which move the diaphragm. This device and its associated circuit, which is shown in Figure 4, may be made so that it will be sensibly flat in characteristic over an extremely wide range.

The great disadvantage of the condenser transmitter is that it has a very low output and very high impedance so that it must have extremely careful shielding and insulation. Imperfect insulation between the back plate and ground will result in current leakage and will cause an irritating popping noise. If the device is imperfectly shielded it will pick up any stray fields within a wide area.

We are accustomed to two megohm grid-leaks in our receivers but the insulation between the plates of this device must be practically infinite. One noisy transmitter was found to have a resistance, between terminals, of 500 megohms.

Noisy microphones have to be care-

(*Continued on page 162*)

A MODERN BATTERY OF MICROPHONES

This is a popular type of microphone unit; this particular installation was used at the broadcasting of the inauguration of President Coolidge. Six double-button microphones were employed to obtain a high quality pick-up.

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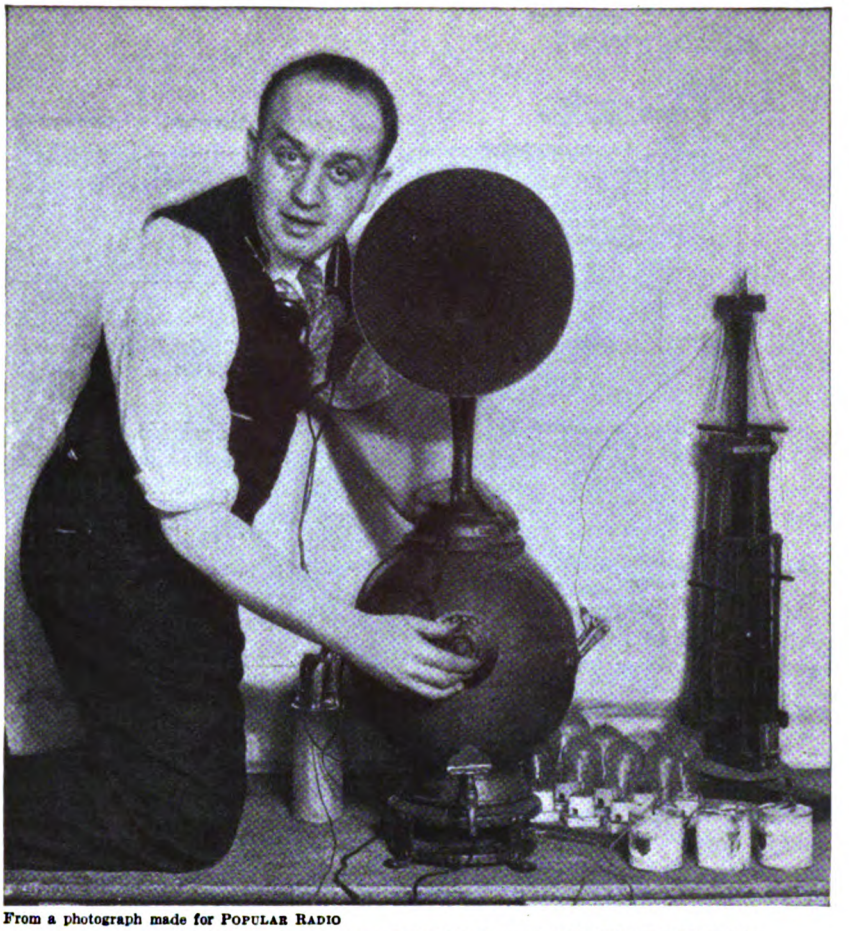
Radio *á la Carte*

(Inventions marked* are ready)

Four remarkable contributions to the radio art by an amateur who "never took a lesson in his life"

By ARTHUR L. LIPPMANN



From a photograph made for POPULAR RADIO

THE OPERATION OF THIS SET MAY BE SUMMARIZED AS "AWFULLY SIMPLE, SIMPLY AWFUL"

"There is no need of expensive equipment in assembling these sets" claims the author, "In fact, I urned this particular set myself. A thermos vacuum bottle, a few milk condensers, an old grid iron—and the trick is done."

The Degenerative Cougher*

With Push-pulmonary Amplification.

Frequent theatre-goers have become so accustomed to hear coughing in the theatre that the absence of these agreeable sounds has marred many an otherwise pleasant evening spent listening in to the radio at home.

My new Degenerative Cougher uses one bronchial tube and can be connected to your set in a moment.

At suitable intervals during the broadcasting of a play or concert, it will emit raucous hawkings through your loudspeaker. These sound so life-like that it will be hard for you to realize that you are sitting comfortably at home instead of in row H on the aisle.

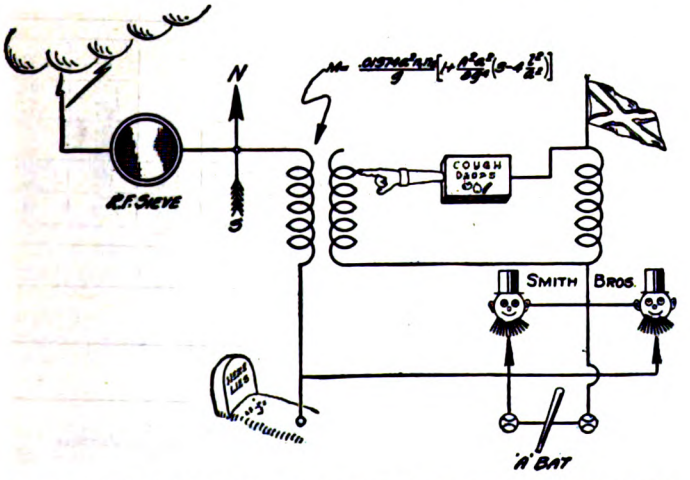
The set employs a croop aerial and has been referred to as the "one-lung larynx" circuit; and it faithfully reproduces all varieties of cough from simple asthma to chronic bronchitis.

The Titillating Titterdyne*

Because the humor of wise-cracking radio announcers usually falls so flat, I early discerned the necessity for an appliance such as a chuckler coil that would generate laughter, no matter how banal the comedy of the announcer.

Simple but ingenious, this attachment automatically ejects graduated quantities of laughing gas from a small vial in the primary circuit as needed. For example:

Let X = Bum Joke
G = Laughing Gas
$\therefore X+G$ = Series of Mild Chuckles
$\therefore XG$ = A Perfect Scream



THE FINAL LAY-OUT OF THE DEGENERATE COUGHER

FIGURE 1: *The author layed out this hook-up all by himself "Some of the connections," he explains, "are remote but wealthy."*

The Dynamic Discriminator*

Employing a Series of Three Educated Grid Leaks

Statistics in Illinois for 1924-25 revealed the astonishing fact that 66⅔ percent of the insane radio listeners had become mad through hearing such selections as "The Road to Mandalay" and "At Dawning" sung five or six times during the course of one evening.

The Dynamic Discriminator's Educated Grid Leaks will prevent this condition. Each is filled with two ounces of TNT, and functions as follows:

Educated Grid Leak No. 1 (Ph. D. Harvard): Automatically explodes after the fourth singing of "Macushla" on any one evening.

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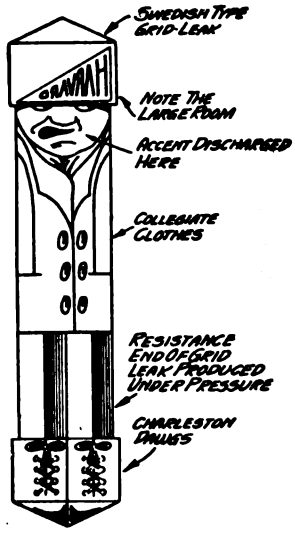
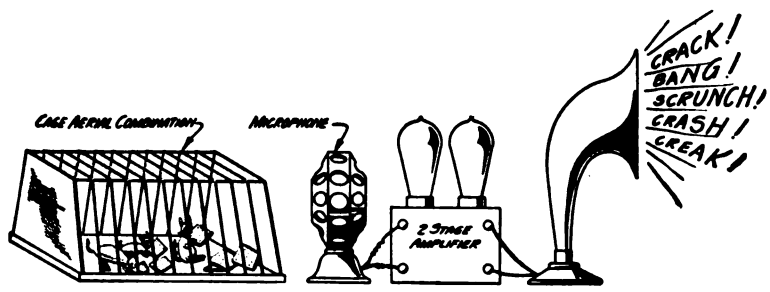


AN EDUCATED GRIDLEAK
(SOMEWHAT EXAGGERATED)

FIGURE 2: *The peculiar functions of this apparatus limits its use exclusively to the Dynamic Discriminator Receiver.*

Educated Grid-leak No. 2 (B. A., M. A. Dartmouth): Blows up your set at the first bar of "Humoresque" or "Kashmiri Song." Model B goes off as soon as announcer says, "You will now hear 'The Road to Mandalay', sung by . . . . "



A UNIQUE STATIC DEVICE

FIGURE 3: *Good, old-fashioned static from contented, healthy mice—that is the secret of the Static Influx circuit shown above.*

Educated Grid Leak No. 3 (Unusually brilliant; educated at Leipsic and Heidelberg): Trained to wreck your set upon the third rendition from any station in one evening of "The Shooting of Dan McGrew" or "Gunga Din." Model B explodes as soon as any "old time fiddlers" are announced.

The Static Influx*

Radio without static is like corned beef without cabbage. Staticless radio sounds unnatural and artificial. Several years of radio listening has educated us to expect a little static to leaven the program. Some cold, clear nights the music doesn't soothe, doesn't entertain. Something is lacking—there is a void. **Do** you know what you're missing?

Static!

In the Static Influx Receiver, concealed in a little tin cage before the second audio stage, I have placed a trained mouse and a box of ordinary soda crackers. When you tune in, the crackers are automatically shoved into the mouse apartment.

"Crackle! Crackle! Crunch!" comes the noise from the mouse cage through the audio amplifiers and into your loudspeaker, assuring you of Grade A, dependable static whenever you need it to perfect the program.

Two spare mice and a dozen soda crackers are essential with each Static Influx.

GENERAL								DETECTION					AMPLIFICATION						
DETECTORS AND AMPLIFIERS																			
TUBE	USE	BASE	MAXIMUM OVERALL DIAMETER	MAXIMUM OVERALL HEIGHT	"A" BATTERY VOLTAGE (SUPPLY)	FILAMENT TERMINAL VOLTAGE	FILAMENT CURRENT (AMPERES)	DETECTOR GRID RETURN LEAD TO	GRID LEAK (MEGOHMS)	GRID CONDENSER (MFD)	DETECTOR "B" BATTERY VOLTAGE	DETECTOR PLATE CURRENT (MILLIAMPERES)	AMPLIFIER "B" BATTERY VOLTAGE	AMPLIFIER "C" BATTERY VOLTAGE	AMPLIFIER ◆ PLATE CURRENT (MILLIAMPERES)	OUTPUT RESISTANCE ◆ (OHMS)	MUTUAL CONDUCTANCE ◆ (MICROMHOS)	VOLTAGE AMPLIFICATION FACTOR	UNDISTORTED OUTPUT (MILLIWATTS)
UX - 201 - A	Detector Amplifier	Large Standard UX Base	1 11/16"	4 11/16"	6 Storage	5.0	.25	+F	2 to 9	.00025	45	1.5	135 90	9 4½	2.5 2	11,000 12,000	725 675	8 8	55 15
UV - 199	Detector Amplifier	Uv 199 Base	1 1/16"	3 1/2"	Dry Cell 4½ Storage 4	3.0	.06	+F	2 to 9	.00025	45	1	90	4½	2.5	16,500	380	6.25	7
UX - 199	Detector Amplifier	Small Standard UX Base	1 3/16"	4 1/8"	Dry Cell 4½ Storage 4	3.0	.06	+F	2 to 9	.00025	45	1	90	4½	2.5	16,500	380	6.25	7
WD - 11	Detector Amplifier	WD 11 Base	1 3/16"	4 1/8"	Dry Cell 1½ Storage 2	1.1	.25	+F	3 to 5	.00025	22½ to 45	1.5	90	4½	2.5	15,000	400	6	7
WX - 12	Detector Amplifier	Large Standard UX Base	1 1/16"	4 11/16"	Dry Cell 1½ Storage 2	1.1	.25	+F	3 to 5	.00025	22½ to 45	1.5	90	4½	2.5	15,000	400	6	7
DETECTORS																			
UX - 200	Detector Only	Large Standard UX Base	1 11/16"	4 11/16"	6 Storage	5.0	1.0	-F	½ to 2	.00025	16½ to 22½	1	—	—	—	—	—	—	—
UX - 200 - A	Detector Only	Large Standard UX Base	1 11/16"	4 11/16"	6 Storage	5.0	.25	-F	2 to 3	.00025	45	1.5	—	—	—	—	—	—	—
POWER AMPLIFIERS																			
UX - 120	Power Amplifier Last Audio Stage Only	Small Standard UX Base	1 3/16"	4 1/8"	Dry Cell 4½ Storage 4	3.0	.125	—	—	—	—	—	135	22½	6.5	6,600	500	3.3	110
UX - 112	Power Amplifier	Large Standard UX Base	1 11/16"	4 11/16"	6 Storage	5.0	.5	—	—	—	—	—	157½ 135 90	10½ 9 6	8 6 2.5	4800 5500 8800	1670 1435 890	8.0 7.9 7.9	195 120 40
UX - 171	Power Amplifier Last Audio Stage Only	Large Standard UX Base	1 11/16"	4 11/16"	6 Storage	5.0	.5	—	—	—	—	—	180▼ 135▼ 90	40½ 27 16½	20 16 10	2000 2200 2500	1500 1360 1200	3.0 3.0 3.0	700 330 130
UX - 210	Power Amplifier Oscillator	Large Standard UX Base	2 7/16"	5 3/8"	7½ 8 6 Type 5 6 6 6	7.5 7.5 7.5 6.0 6.0 6.0	1.25 1.25 1.25 1.1 1.1 1.1	—	—	—	—	—	425▼ 350▼ 250▼ 157½ 135 90	35 27 18 10½ 9 4½	22 18 12 6 4.5 3	5000 5100 5400 7400 8000 9700	1550 1500 1320 1020 940 775	7.7 7.6 7.3 7.5 7.5 7.5	1940 925 360 90 65 18
RECTIFIERS																			
MODEL	USE	BASE	MAXIMUM OVERALL DIAMETER	MAXIMUM OVERALL HEIGHT	PURPOSE														
UX - 213	Full Wave Rectifier	Large Standard UX Base	2 7/16"	5 3/8"	For use in rectifying systems particularly designed for this Tube	Filament Terminal Voltage Filament Current Max. AC Input Voltage per plate Max. Rectified Current (both plates)							5.0 Volts 2.0 Amperes 220 Volts (RMS) ▲ 65 Milliamperes						
UX - 216 - B	Half Wave Rectifier	Large Standard UX Base	2 7/16"	5 3/8"	For use in rectifying systems particularly designed for this Tube	Filament Terminal Voltage Filament Current Max. AC Input Voltage Max. Rectified Current							7.5 Volts 1.25 Amperes 550 Volts (RMS) ▲ 65 Milliamperes						

▼ Loudspeaker coupling recommended at this plate potential due to large plate current.
◆ At indicated "B" and "C" battery voltages.
▲ R M S indicates "Root Mean Square" as indicated on an AC voltmeter.
▲▲ Connection to shell of base for third terminal which is the lead to mid point of filament.

A TABLE THAT TELLS YOU WHAT TUBES TO USE

All of the standard types of vacuum tubes are given above with their filament, grid and plate characteristics as to standard applied voltages. The table also tells the use of the tubes and gives other ratings that should be helpful to the experimenter.

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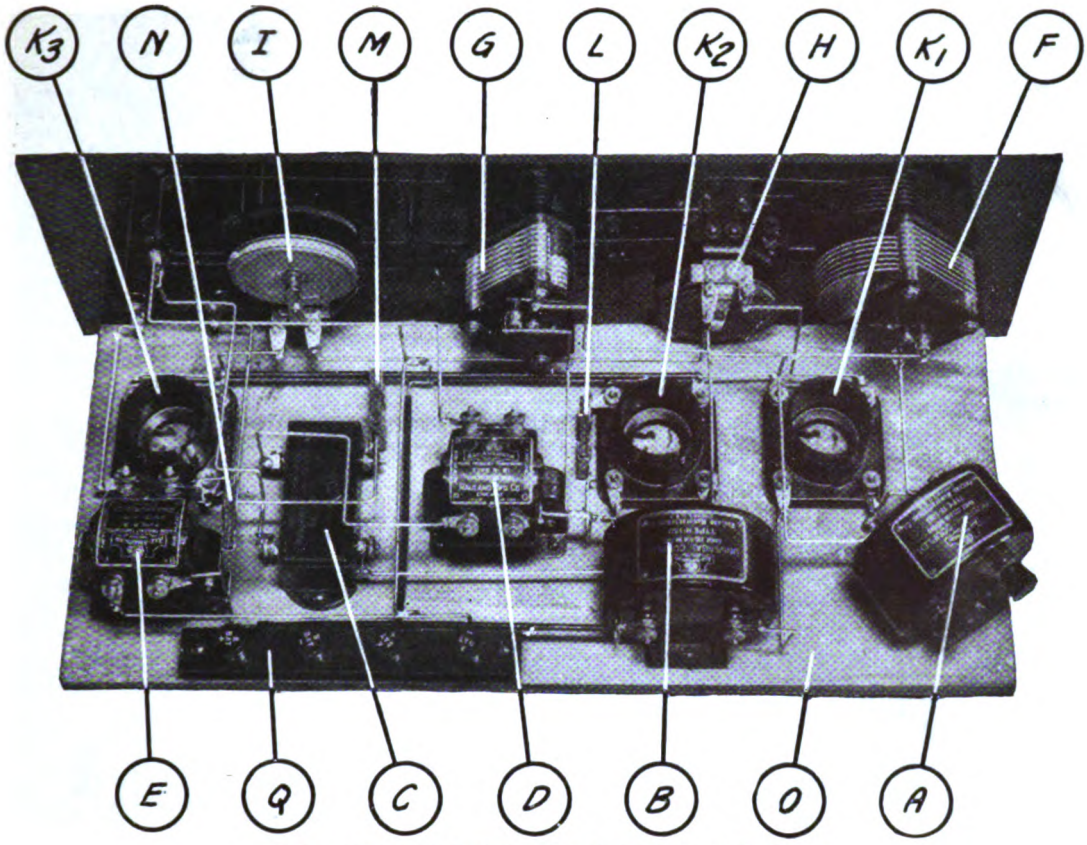

HOW THE RECEIVER LOOKS FROM THE REAR

FIGURE 1: *This picture shows the general arrangement of all the parts mounted on the baseboard and on the back of the main panel. Notice the neat arrangement of the units and the easy wiring scheme.*

HOW TO ASSEMBLE THE

All-Amax Senior Three-tube Reflex Receiver

This is the first of the series of articles on the assembly and operation of popular kits of parts that may be obtained for building really good radio receivers. These articles will differ from the regular "How-to-Build" articles in that the set described has been designed outside of POPULAR RADIO LABORATORY by commercial engineers. The sets that will be picked for description, however, will have been carefully tested in the POPULAR RADIO LABORATORY and have been chosen for their outstanding features and all-around efficiency.

By MORRIS M. SILVER

COST OF PARTS: *Not more than $44.00*

HERE ARE THE PARTS THAT ARE CONTAINED IN THE KIT—

A and B—All-American Universal coupler, type R-140;
C—All-American radio-frequency transformer;
D and E—All-American audio-frequency transformer, type R-21;
F and G—Bremer-Tully bakelite end plate variable condenser, .0003 mfd.
H—Carter rheostat, 6 ohms;
I—Carter rheostat, 30 ohms;
J—Grewol or Rasla fixed crystal detector;
K1, K2 and K3—All-American 201-a type sockets;
L—Dubilier type 601 mica condenser, .00025 mfd.;
M—Dubilier type 601 mica condenser, .0001 mfd.;
N—Dubilier type 601 mica condenser, .0005 mfd.;
O—baseboard, 6⅞ inches by 17 inches;
P—composition panel, 7 inches by 18 inches;
Q—composition binding-post strip, ¾-inch by 6 inches;
R—binding-post strip supports consisting of ¼-inch brass tubing each ⅝-inch long;
S—standard cabinet for 7 inch by 18 inch panel;
6 binding posts, wood screws, bus bar, etc.

THE theory of operation of an ordinary receiver is so generally understood by the amateur builder that there is no necessity for describing it here. The theory of the reflex principle is not so thoroughly understood, however, and the home-builder is advised to study it before he starts out to construct this receiver.

The first tube and its accompanying equipment, in the All-Amax Senior receiver serves as one stage of straight, radio-frequency amplification, with its input tuned by the variable condenser, F. The output of this stage is, of

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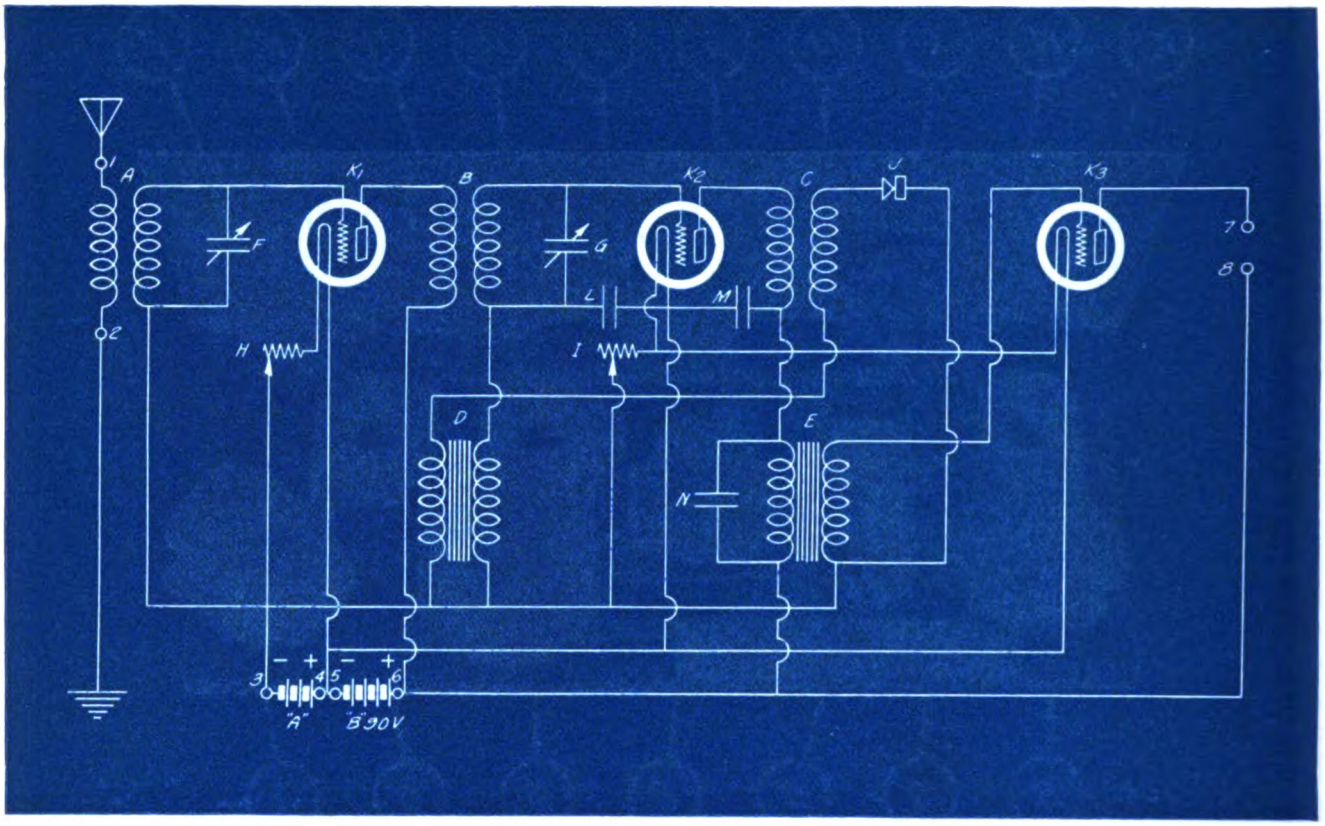
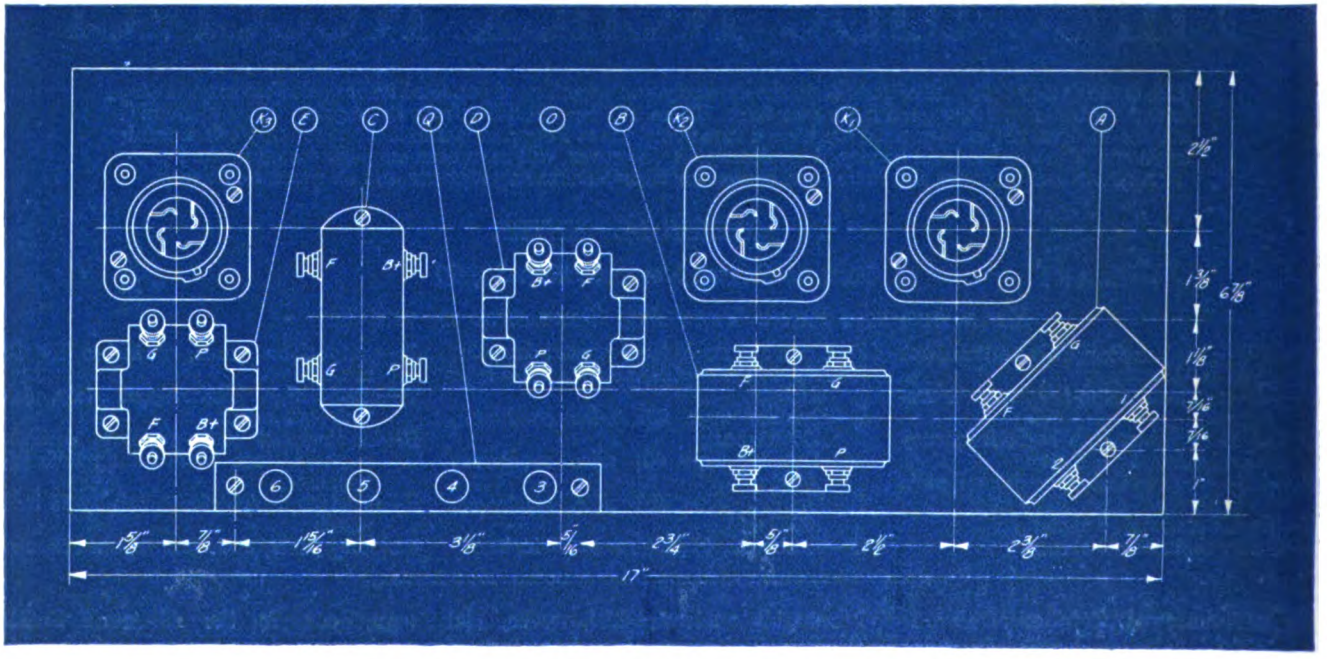


THE SCHEMATIC WIRING DIAGRAM

FIGURE 2: *This drawing shows, in schematic form, the circuit used in this simple receiver. An "A" battery voltage of 6-volts and a "B" battery voltage of 90-volts is sufficient for ordinary operation of this receiver.*

¶ *The list of parts given on page 147 includes the exact instruments used in the kit from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*



THE WORKING DRAWING FOR CONSTRUCTION

FIGURE 3: *All of the parts should be mounted on the baseboard in the exact positions shown here; these positions are determined from center to center for all of the instruments.*

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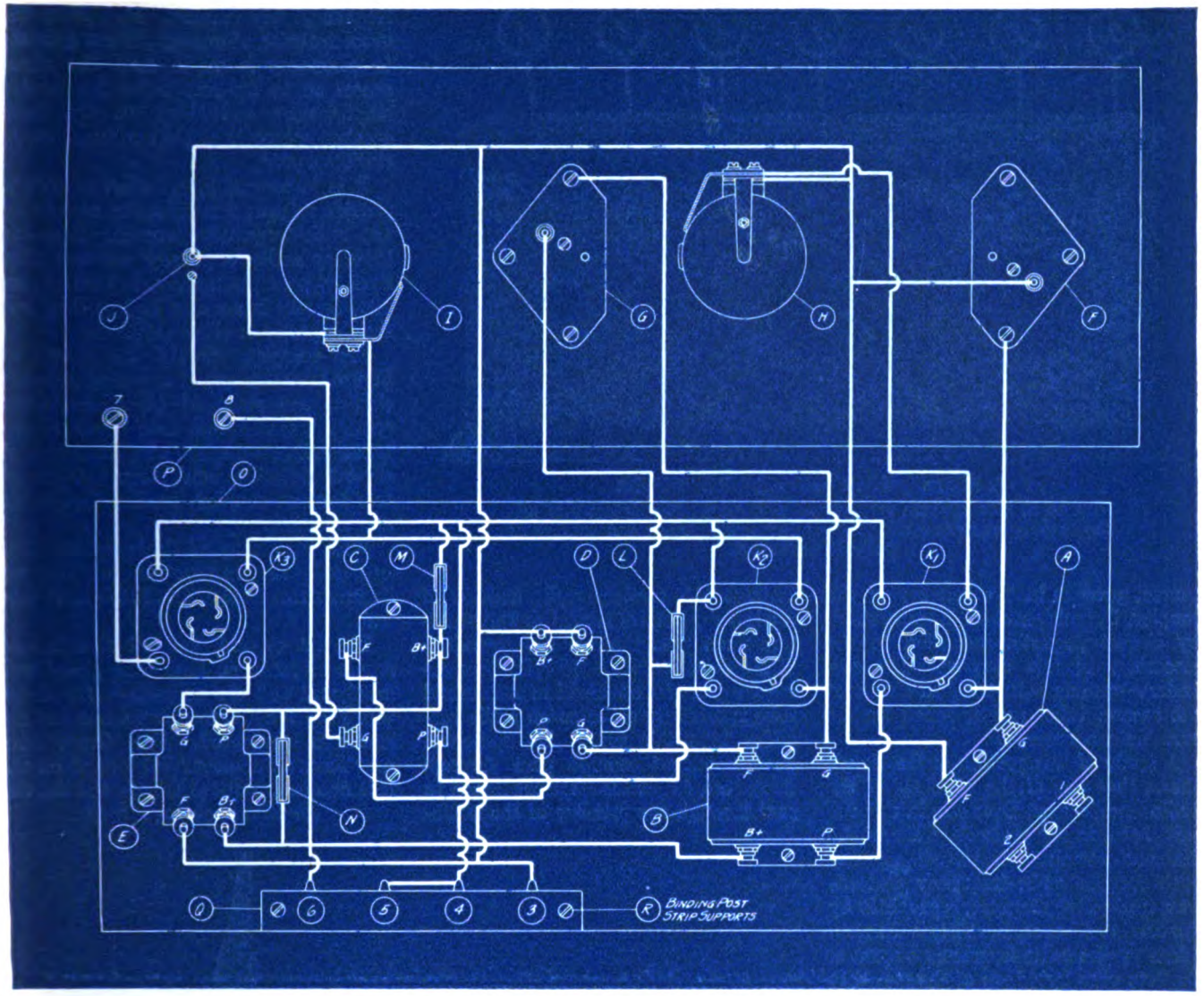
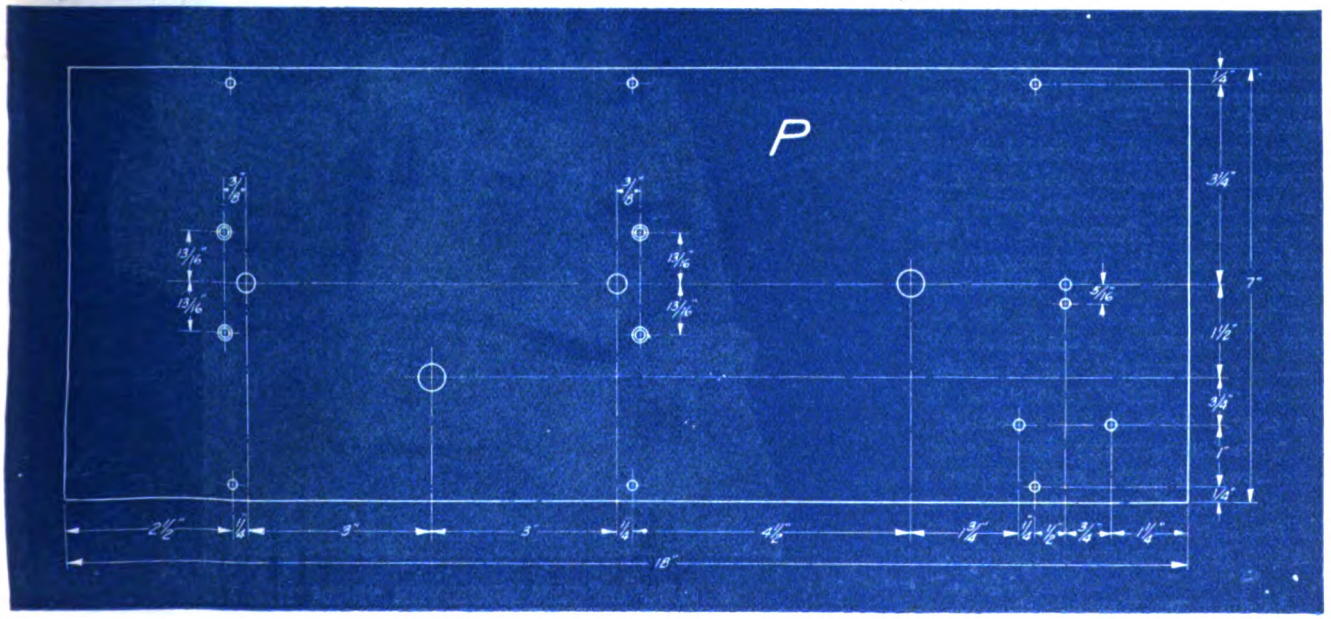


THE PICTURE WIRING DIAGRAM

FIGURE 4: *The instruments in this diagram are drawn in about their relative positions.*



HOW TO DRILL THE PANEL

FIGURE 5: *This drawing gives the exact drilling plan of the panel used in the receiver kit.*

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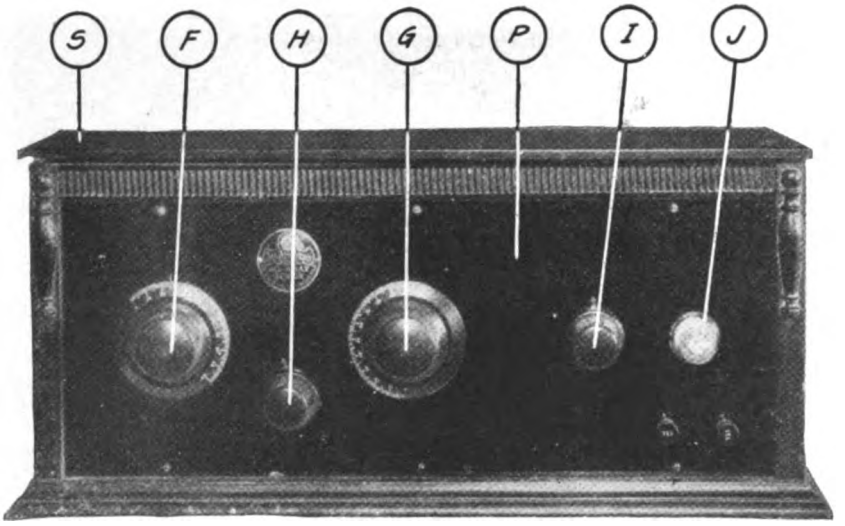


A FRONT VIEW OF THE RECEIVER

FIGURE 6: *The controls are marked with designating letters that will enable the operator to easily pick out the proper knobs and controls as outlined in the text.*

course, present in the primary of the coupler, B, and from here is transferred, by electro-magnetic induction to the secondary of this coupler. The secondary winding is in the grid circuit of the second tube, and is tuned by the variable condenser, G.

A study of this portion of the circuit shows that one of the windings of the audio transformer, D, is also in this circuit, between the grid coil of B and the filament circuit. However, another path for the radio-frequency current, from grid coil to filament, is provided by the fixed condenser, L. This is the path taken by the radio-frequency output of the first tube by virtue of the fact that radio-frequency currents can pass through a small fixed condenser without hindrance, while they will not pass readily through the windings of an audio transformer. In considering the radio-frequency portion of this circuit, therefore, the winding of the audio-frequency transformer, D, may be disregarded.

The same condition exists in the output circuit of the second tube which includes the tube plate, the primary of the untuned transformer, C, and the fixed condenser, M. The energy in this circuit is transferred by electro-magnetic induction, as before, to the secondary of coupler C, in the circuit with which is the crystal detector, J, and the primary of the audio transformer, D. The crystal detector has a rectifying action on the incoming signal energy and converts it from a radio-frequency current to one of audio frequency, and this audio-frequency current is transferred to the secondary of transformer D.

Here the action is exactly the reverse of the action described above. The audio-frequency current cannot pass through the condenser, L, because of the low capacity of the latter and therefore must pass through the secondary of the transformer, B, in order to operate the grid of the tube. Thus this second tube is made to serve as an audio amplifier tube this time. Its audio-frequency output cannot pass through condenser, M, and is therefore forced to pass through the primary of the audio-frequency transformer, E. Here the usual transfer of energy, from primary to secondary is made and the signal passes on to the last tube for further amplification and then to the loud-speaker where it is reproduced as an audible sound.

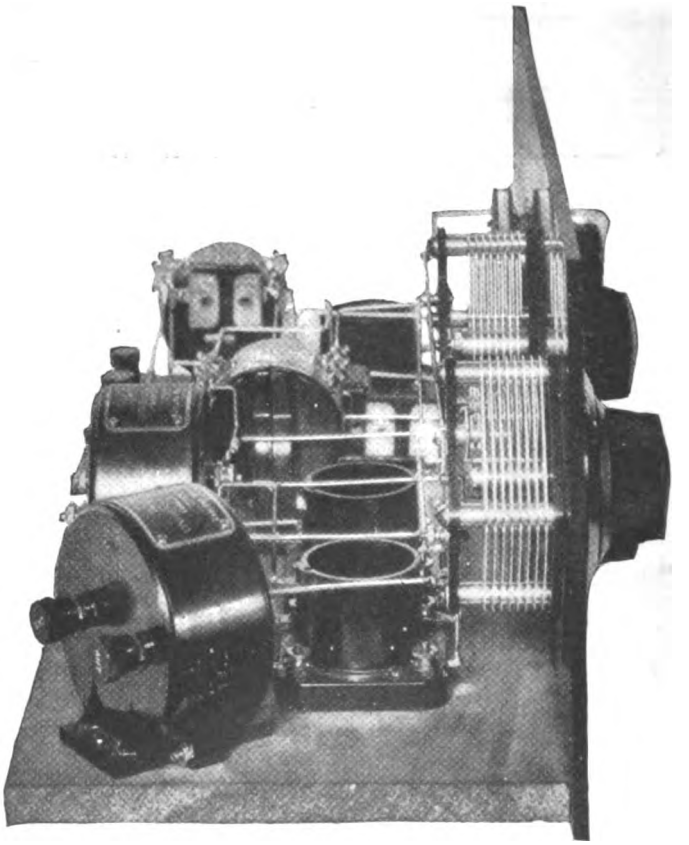
It is important in a reflex circuit to provide adequate means for separating the radio-frequency current from the lower or audio-frequency current. The fixed by-pass condensers, L and M, are vital factors in accomplishing this, and their capacity is often critical.

The complete circuit, as shown in Figure 2, makes use of a tuned antenna circuit, one stage of tuned-radio-frequency amplification, one stage of untuned-radio-frequency amplification, a crystal detector, and two stages of transformer-coupled, audio-frequency amplification.

With the theory of the receiver thus outlined the construction of the set becomes more understandable and logical.

The kit as sold, has all the instruments mounted on both the panel and baseboard and the necessity, for those who have the kit, to mount the instruments is eliminated. For those who may have an unassembled kit of parts, it is necessary only to follow the details

(*Continued on page 166*)



A VIEW OF THE RECEIVER FROM THE LEFT

FIGURE 7: *A side view of the coils, condensers and tube sockets and their method of assembly on the wood baseboard and the panel may be seen in this illustration.*

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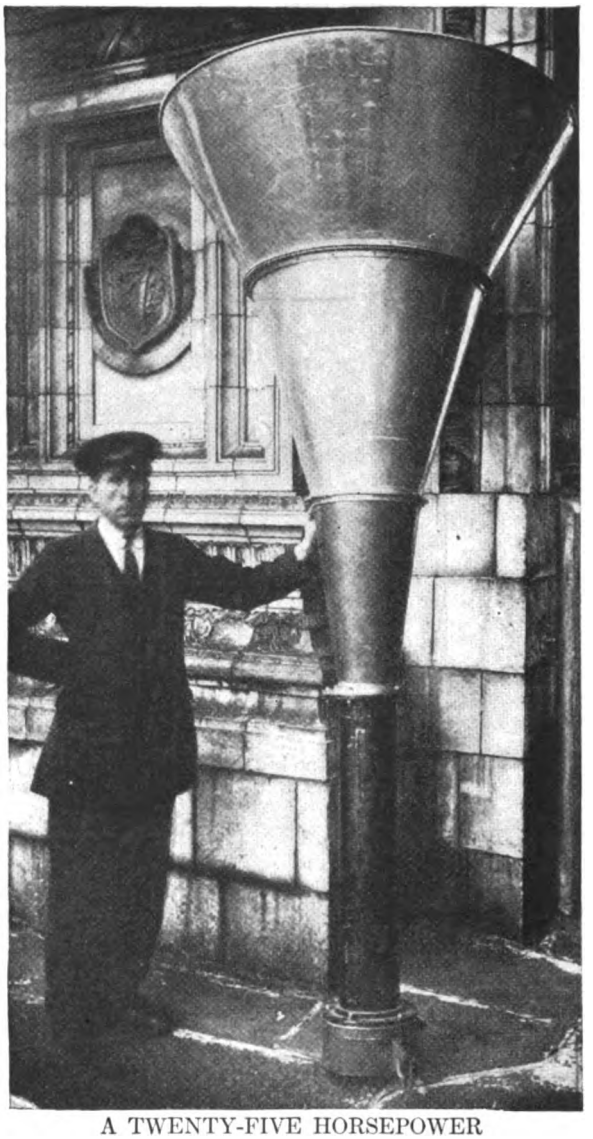
What's New *in* Radio

Conducted by
THE TECHNICAL STAFF

Inventors, experimenters, manufacturers and readers generally are invited to keep the Technical Staff of POPULAR RADIO informed of all new apparatus that is of their own creation or that comes to their attention; if the apparatus passes the tests of the POPULAR RADIO LABORATORY it will be duly recorded in this Department for the information and benefit of all.

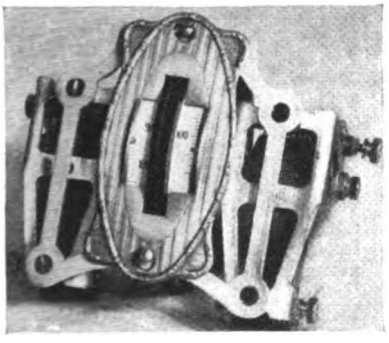
A Unit for a Home-made Loudspeaker

Name of instrument: Loudspeaker unit.
Description: This is a new floating armature type of reproducer motor for actuating a horn that may be built at home, or for use in combination with a phonograph horn. It contains a new diaphragm of specially drawn aluminum and is very efficient at both high and low frequencies.
Usage: As an actuating device in a home-built loudspeaker or phonograph.
Outstanding features: High efficiency. Reproduces high and low notes with equal fidelity of tone quality. Rugged construction of unit.
Maker: Bert E. Brown.



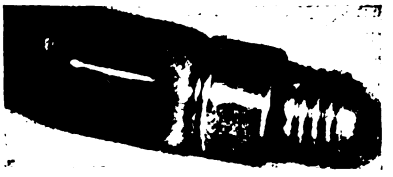
A TWENTY-FIVE HORSEPOWER LOUDSPEAKER

This huge horn reproducer is an experimental unit built by the Marconi Company to determine how much current a loudspeaker can be constructed to carry. This model will use as much as 20,000 watts, the equivalent of about 25 horsepower.



This Device Allows Two Circuits to be Tuned Individually or Together as a Single Unit

Name of instrument: Dual tuning condenser with a special control.
Description: This unit consists of two well-made and efficient straight-line-frequency variable condensers, sturdily mounted on a metal frame and equipped with individual, calibrated drum-scales. The unit is so designed that these twin drums project through a rectangular hole cut in the panel of the receiver and covered by a bronze escutcheon plate, which is provided with the instrument. The drums project through the panel, side by side, and on their inner edges have knurled flanges which provide the necessary finger grip for use in tuning. These drums may be rotated individually using both hands or they may be rotated together by allowing one finger to grip both flanges. Thus, the two circuits, to which this instrument is connected may be controlled as a single circuit or, individual adjustments may be made.
Usage: As the capacity tuned element in a receiver having two tuned circuits.
Outstanding features: Sturdy construction. High efficiency. Neat appearance. Simple to install and operate.
Maker: Bruno Radio Corp.



A New Rectifier Tube for Trickle Chargers

Name of instrument: Rectifier valve for trickle chargers.
Description: This is a new tube of the Tungar family and is especially designed as a half-wave rectifier for use in trickle chargers; it delivers a charging current to the battery of one ampere or less. A trickle charger equipped with this rectifier requires absolutely no attention on the part of the owner.
Usage: In trickle chargers specially designed to accommodate this tube.
Outstanding features: Positive operation. Foolproof. Requires no attention.
Maker: General Electric Co.

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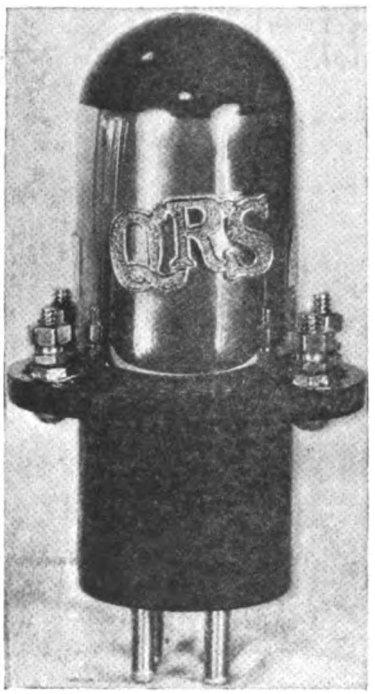
Herbert

AN IDEA FOR A HAND-PAINTED LOUDSPEAKER

This decorated reproducer is of the eccentric cone type; the driving pin is located near the bottom of the speaker, instead of at the center, to give the speaker a wider frequency range.



A Power Tube That Will Improve an Old Receiver

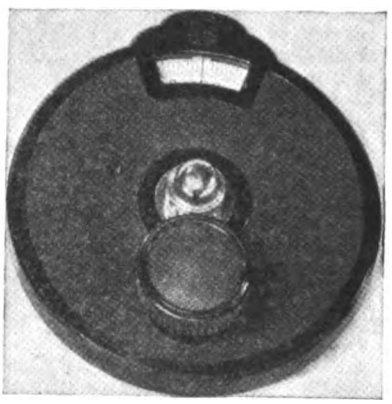
Name of instrument: Power tube and adapter.

Description: This new tube, which is capable of handling large powers, is designed especially for the last stage of amplification. It is equipped with four extra binding posts for connecting externally, to the wiring of the set, additional "B" and "C" batteries to get the utmost in volume and quality from the receiver the tube is used with.

Usage: In connection with a receiver for adapting the receiver to power tube operation in the last stage of audio-frequency amplification.

Outstanding features: Capable of handling higher power. May be installed in an old set without rearranging the wiring. Easy to install. Gives improved operation.

Maker: Q.R.S. Music Co.



A Dial That Will Improve the Appearance of Your Panel

Name of instrument: Tuning control.

Description: This control is entirely contained in a neat circular bakelite molding and is equipped with a window through which the numbers and dial settings revolve under a hair line, for accurate adjustment. It is designed to be placed on the front of the panel and is attached by means of a set screw that fastens to the shaft of the tuning instrument with which it is to be used.

Usage: As a tuning control in any radio-frequency circuit.

Outstanding features: Neat, mechanical design. Smooth operation. Clear vision, when mounted on a panel.

Maker: Samson Electric Co.

A Safeguard Against Short Circuits in the Battery Connections

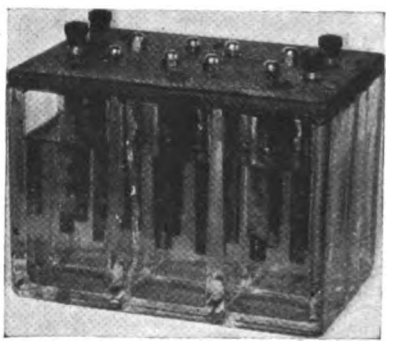
Name of instrument: Fused battery connection cable.

Description: This is a standard, seven-wire, coated, battery cable with terminals at one end to connect to the batteries and corresponding terminals at the other end to connect to the receiver. The special advantage of this cable lies in the fact that it is equipped with a small bakelite container which holds fuses in the "A" and "B" battery circuits. Thus, if either of these circuits are short-circuited or improperly connected, the fuses will blow out, thus eliminating any possibility of damage to the tubes or batteries.

Usage: As a connecting cable between the batteries and a radio receiver.

Outstanding features: Well made. Neat appearance. Provided with fuses to protect batteries and tubes from accidental short circuits or burn outs.

Maker: Belden Mfg. Co.



A Unit That Eliminates Rectifier Tubes and Gives Increased Voltages

Name of instrument: Rectifier cell.

Description: This new six-cell rectifier may be connected to any of the standard "B" power-packs as a rectifying element. The voltage drop across the cell is less than in ordinary rectifying tubes and this cell will raise the voltage of a "B" power-pack considerably. It is designed to be used as a full-wave rectifier. The elements are mounted rigidly in an insulated case, the top portion of which is of molded insulating material; the bottom jar portion is of glass. It is equipped with four binding posts and makes a rigid, strong, unspillable cell. The liquid used is non-corroding and needs replacing with distilled water only two or three times a year.

Usage: In connection with a "B" power-pack as a rectifier.

Outstanding features: High efficiency. Neat appearance. Compact. Not mussy. Easily installed.

Maker: Auto Vacuum Products Co.

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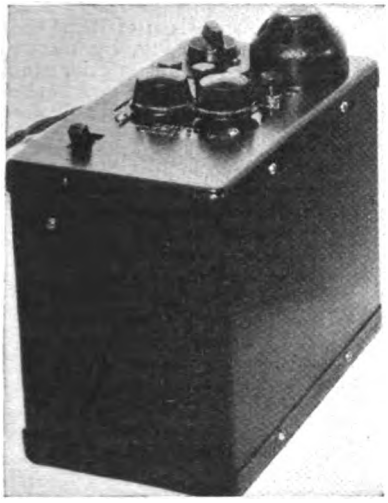


A "B" Power-pack to Supply Variable Voltages

Name of instrument: "B" battery eliminator.

Description: This unit, which is completely enclosed in a black metallic case, will furnish all the necessary plate voltages to any standard receiver. It is equipped with terminals to provide three different voltages to the receiver and has a sufficiently high voltage to operate either a UX-112 or UX-171 type power tube at maximum efficiency. The device is equipped with an extension cord and plug to plug into any 110-volt, 60-cycle, alternating current lighting line.

Usage: To supply all plate voltages to radio receivers.

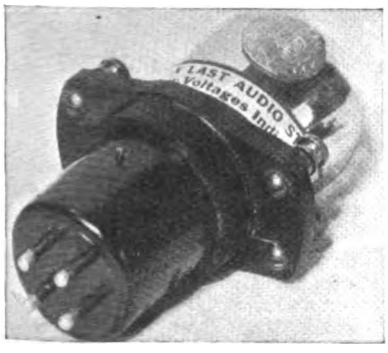
Outstanding features: Quiet operation. Substantial construction. Has variable controls which can be adjusted to provide the exact required voltages to any receiver. It is equipped with an "on" and "off" switch and also with a rheostat to vary the alternating current input as desired.

Maker: Kokomo Electric Co.

Herbert

A COMPACT SUPERHETERODYNE WITH A NOVEL INDICATOR SCALE

The strange panel design of this seven-tube set built by Mr. Wei Yoh Wu, is due to the indicator system; each knob actuates a belt which moves the indicating arrow up and down the length of the scale.



An Attachment that Brings An Old Receiver Up to Date

Name of instrument: Combination power tube and adapter.

Description: This new power tube is equipped with the standard base and also with two sets of binding posts that may be used for connecting additional "B" and "C" batteries to an old receiver that did not use a power tube. The tube may simply be placed in the last stage socket and the additional "B" and "C" voltages directly attached to the binding posts intended for this use that are mounted on the extension base of the tube itself.

Usage: In connection with an old-type receiver for using power amplification.

Outstanding features: Rugged construction. Efficient operation. Long life. Brings an old set up to date.

Maker: Van Horne Co.

A Tube with Better Characteristics for Radio-Frequency Work

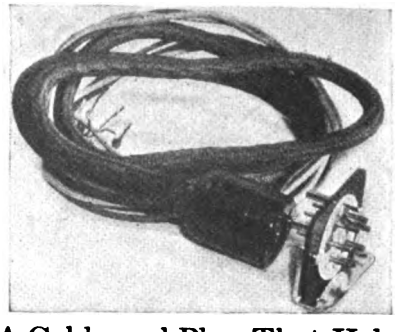
Name of instrument: Vacuum tube.

Description: This tube in appearance is similar to a standard vacuum tube equipped with the UX type prongs. The interior construction and the evacuated process used, make the tube exceptionally satisfactory for use in a radio-frequency amplifier. The tubes run uniform in inter-element capacity which makes them very stable in operation in balanced circuits.

Usage: In a receiving set as a vacuum-tube amplifier and more especially for radio-frequency amplification.

Outstanding features: Equipped with the new standard base. Especially satisfactory characteristics for radio-frequency work. Long life.

Maker: Cleartron Vacuum Tube Co.



A Cable and Plug That Helps to Prevent Shorts

Name of instrument: Battery cable.

Description: This cable connector consists of seven leads that may be used for the "A," "B" and "C" batteries. These wires terminate in a connection plug that is suitably insulated and fits a socket that may be connected to the receiving set itself in place of binding posts.

Usage: For a receiving set installation between the batteries and the set.

Outstanding features: Neat in appearance. Easy to install.

Maker: Yaxley Mfg. Co.

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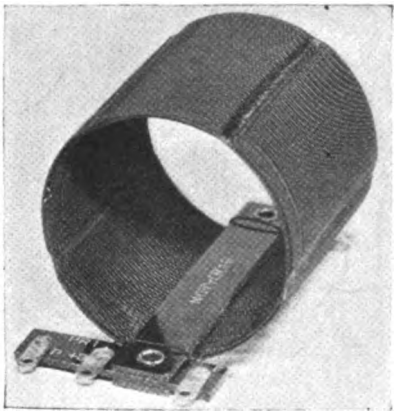
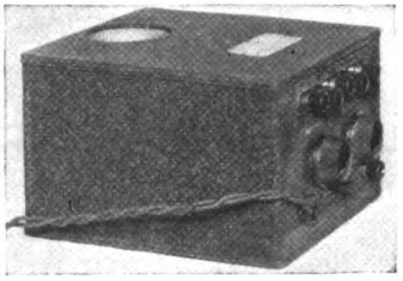


A Coil to Increase the Radio-Frequency Amplification in an Old Set

Name of instrument: Radio-frequency coupling coil.
Description: This unit consists of a primary and secondary winding wound by the exclusive Benjamin process that gives a self-supporting coil of extremely low distributed capacity and high inductance. The bakelite mounting strip is provided with eyelets so that it may be screwed down to a baseboard. This strip also carries the terminals that are connected to the other parts of the circuit.
Usage: In a radio-frequency amplifier as an interstage coupling.
Outstanding features: Low resistance. Low distributed capacity. High inductance. Easy to install in a receiver.
Maker: Benjamin Electric Mfg. Co.

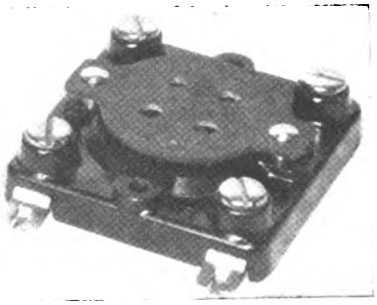
A Device that Improves Quality of Reproduction and Protects the Loudspeaker

Name of instrument: Loudspeaker filter.
Description: This new unit comprises a high inductance choke coil in combination with a large capacity condenser that is incorporated in a shielded metal can and that should be connected in the plate circuit of the power tube in all modern receivers. The high inductance choke coil has a high enough inductance at low frequencies to obtain the full output of the power tube and the condenser is so connected that the direct current cannot flow through the loudspeaker. When this device is used only the voice or musical current that actually produces the sounds in the loudspeaker is fed through the loudspeaker windings, thus preventing burnt windings when large power tubes or high voltages are used.
Usage: In connection with a modern receiver as a DC output filter.
Outstanding features: Produces better quality on the low notes. Takes DC load off the loudspeaker. Protects the operator from serious shock when inserting the loudspeaker into the jack.
Maker: General Radio Co.



A Power-pack that Eliminates Battery Problems

Name of instrument: "B" power-pack.
Description: This unit, which is encased in a crystalline metal cabinet, may be used to furnish "B" power to a radio receiver. It is equipped with fixed-voltage terminals of various orders that make it suitable for use with any receiver and it contains two variable taps for detector or amplifier voltages that may be critical in a receiver. It is also equipped with an extension cable that connects directly to the 110-volt, 60-cycle, alternating current lighting mains. It will operate with either the standard, type B, Raytheon tube or with the newer BH type Raytheon tube, where more power is required. It will furnish enough voltage to operate a power tube in connection with any receiver.
Usage: As a "B" power supply in connection with radio receivers employing vacuum tubes.
Outstanding features: Compact. Sturdy construction. Continuous and silent operation. Furnishes high voltage for power tubes.
Maker: All-American Radio Corp.

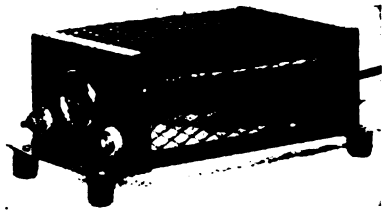


A Positive Contact Socket

Name of instrument: Vacuum-tube socket.
Description: This socket is of molded bakelite and is equipped with contact springs which assure a positive sliding contact on the prongs of any standard vacuum tube. Each of these spring contacts and the lug, by means of which the external connections to the socket are made, are stamped out of a single piece of metal; this eliminates any possibility of a poor connection between the contacts and the socket terminals. The soldering terminals are of special construction, which doubly insure good connections.
Usage: May be used as a holder for any of the standard vacuum tubes in any part of any radio circuit.
Outstanding features: Substantial construction. Firm spring contacts and the elimination of faulty connections from the tube prongs to the external circuit.
Maker: H. H. Eby Mfg. Co.

A Handy Unit for Testing Apparatus

Name of instrument: Circuit testing outfit.
Description: This unit, which consists of two insulated handles equipped with electrodes and suitable connection wire is well insulated. It contains a series glow lamp which is mounted in a socket that may be connected to any AC or DC lighting line for testing open and closed circuits.
Usage: For laboratory testing of wiring or for testing instruments used in radio
Outstanding features: A compact portable unit for testing. Well insulated. Easily set-up. Neat in appearance.
Maker: Universal Test Equipment Co.



A DC Charger for Radio Fans Who Have Direct Current Lighting in Their Homes

Name of instrument: DC charger.
Description: This unit, which is mounted on a substantial metal frame contains resistance elements and a suitable meter for charging storage "A" batteries direct from the DC lighting mains. It is well insulated both from an electrical and a thermal standpoint. It is equipped with suitable terminals for connecting to the "A" battery and an extension cord for connecting to the 110-volt, DC lighting line.
Usage: In connecting with an "A" battery for DC charging.
Outstanding features: Invaluable to set owners where direct current is obtainable. Compact. Easily installed. Safe in operation.
Maker: Ward-Leonard Electric Co.

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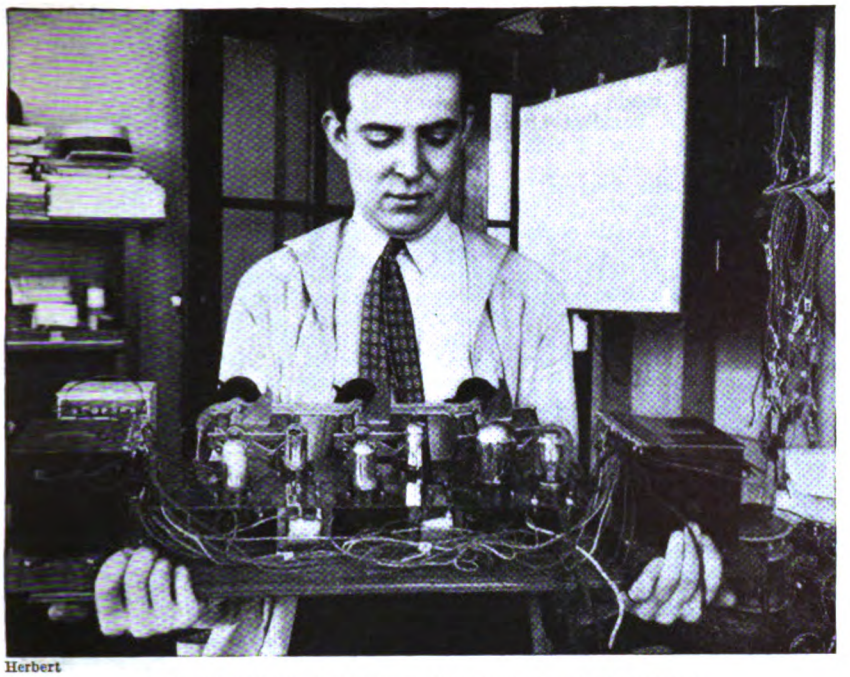

Herbert

A HOME-MADE POWER-OPERATED RECEIVER

Not many fans would care to undertake the construction of a set as intricate as this five-tube, power-operated set built by Harold Herbert appears to be. The first four tubes are of the UX-199 type; the last tube on the right is a type BH Raytheon and is part of the power unit.

A Unit That Will Increase Volume in Your Set

Name of instrument: Audio-frequency amplifying transformer.

Description: A large size transformer carefully mounted in a shielded metal case containing a primary winding of exceptionally high inductances, so that the low tones are amplified with all their full volume and rotundity. The distributed capacity of the transformer is kept low so that the high tones are not minimized and the quality of reproduction is kept even over a wide band of frequencies. It is equipped with a suitable bypass condenser that is mounted inside the case; the terminals are well insulated and substantially mounted in accessible positions for connecting to the battery and tube circuits.

Usage: In connection with a low-frequency amplifier as an interstage coupling device.

Outstanding features: Good reproduction of low tones and high tones. High amplification over a wide band of frequencies. Excellent workmanship. Neat appearance.

Maker: Ferranti Limited.

A Battery-and-Charger that Eliminates Old Time Battery Problems

Name of instrument: Combination trickle charger and storage "A" battery.

Description: This unit comprises three separate cells of the conventional high quality storage battery mounted in a heavy glass container. It also comprises an electrolytic rectifier or charger that keeps the battery in fully charged condition at all times and without any care from the operator. It is equipped with a heavily insulated extension cord for connection to the lighting socket. Outside of occasionally filling with distilled water no other attention is required.

Usage: For supplying "A" current to vacuum tubes.

Outstanding features: Rugged construction. Needs extremely little care. Satisfactory operation.

Maker: Vesta Battery Corp.

An Extremely Compact Raytheon Power-Pack

Name of instrument: Raytheon power-pack.

Description: This unit, which employs a step-up transformer, choke system, and filter condensers with regulating resistances for both the detector and intermediate voltages for amplifiers, is constructed in such a way that it takes up a very small space. It is furnished with a long extension cord for connection to the lighting plug. The unit will furnish an extremely high voltage for the power tube with variable voltages for the other tubes in the circuit as needed.

Usage: In combination with a receiving set for supplying suitable "B" power for all tubes.

Outstanding features: Compact design. High voltages obtained. Easy regulation. Efficient operation with receiver.

Maker: Silver-Marshall, Inc.

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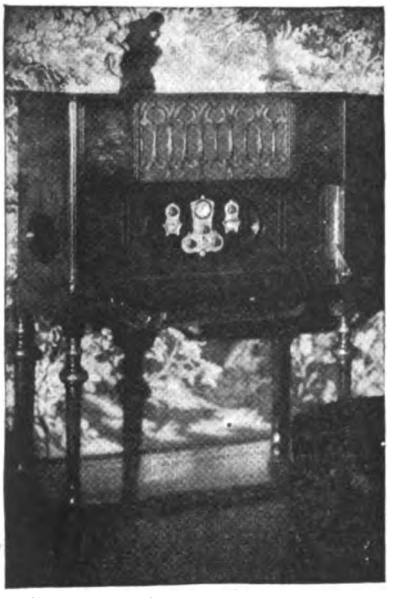


A Seven-tube Receiver that Costs Only One-Fourth of a Cent an Hour to Operate

Name of instrument: Argus Electric Radio Receiver.

Usage: For radio broadcast reception.

Outstanding features: Uses no batteries; draws all operating current from the alternating current lines. Costs less to operate than a single 25-watt lamp. Requires no more technical knowledge to operate than does an electric toaster or any other household device. Absolutely quiet in operation; no hum. Excellent tone quality and volume. Fine appearance.

Description: This seven-tube receiver employs three stages of radio-frequency amplification, detector, and three stages of audio-frequency amplification. Tuning is accomplished by means of two controls which operate calibrated, rotating scales that are located behind small windows in the panel.

In addition to the two tuning controls, three other knobs and a milliammeter are located on the panel. One of these knobs is used to regulate the current supplied to the receiver and its proper adjustment is indicated by the reading of the meter. That is, the knob is turned in a clockwise direction until the pointer on the meter reaches a red mark on the scale. The knob is then left in this position while the receiver is in operation. This knob also serves as a switch to turn the receiver "on" and "off." Another knob, located just above the left-hand tuning scale, is the volume control. The variation obtained with this control is so gradual, that the volume may be regulated to any desired degree from zero to maximum. The last control regulates the sensitivity of the receiver; it is conveniently located just above the right-hand tuning scale. When tuning the receiver for reception from local stations this control may be set at a point which provides suitable sensitivity and may be left at that point permanently. If it is desired to tune in distant stations, however, this control is advanced to a point which provides the maximum degree of sensitivity.

The receiver is housed in two styles; the table-mounting style of cabinet and the high-boy console cabinet containing a built-in loudspeaker. Both cabinets are made in a beautiful burled walnut panelled effect, and are decidedly attractive in appearance.

To install the receiver it is only necessary to plug the extension cord, on the receiver, into the nearest electric lamp socket or wall outlet. The plug is left thus connected permanently as the connection is automatically broken when the receiver is turned "off" by means of the control knob on the panel of the receiver. Wires running to the antenna and to the ground are connected up in the usual manner.

If the receiver is to be used solely for local and semi-distant reception, there is no necessity, in many cases, for an antenna. A special binding post is provided inside of the receiver which may be connected to the binding post in the receiver to which an antenna would ordinarily be connected.

If an outdoor antenna is to be used, its size will be largely governed by local reception conditions. A suitable antenna will be from 50 to 150 feet in length, overall. If the receiver is located close to one or more broadcasting stations, a short antenna will be found best. Where there is no possibility of local interference, a long antenna may be used. In the latter case the installation will have the advantage of somewhat greater volume, in the reception of programs from distant stations, than would be the case were a smaller antenna used. An indoor antenna may be used with gratifying results where for one reason or another it is not desired to have an antenna wire outside.

The tube requirements of this receiver are rather unique, in that a combination of small and large tubes is used. Tubes of the UX-199 type are used for the three stages of high-frequency (radio-frequency) amplification, the detector, and one stage of low-frequency (audio-frequency) amplification. In the second low-frequency stage a standard UX-201-a type tube is used and in the last low-frequency stage a power tube of the UX-171 type is used.

For those readers who are interested in more technical details of this receiver it will be of interest to know that two of the high-frequency amplifier stages are tuned while the third is untuned. The antenna circuit input to the first stage is tuned by means of a variable condenser which is operated by one of the two tuning controls on the panel. The other tuning control operates two condensers which simultaneously tune the input to the second and third high-frequency stage. A small variable balancing capacity is included inside of the receiver for the purpose of synchronizing these two tuned circuits. This balancing capacity need be adjusted only once.

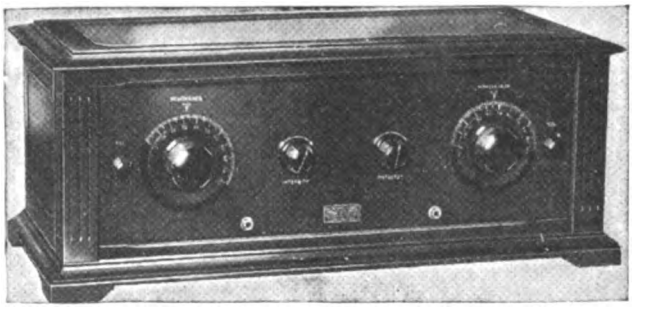
The low-frequency amplifier consists of one stage of the transformer-coupled type, followed by two stages of the impedance coupled type. This combination provides excellent quality and plenty of volume.

The filament current for the five UX-199 type tubes is supplied from the DC output of the electrolytic rectifier and filter. These filaments are connected in series and draw a total of approximately 60 milliamperes. The filaments of the two larger tubes are operated on alternating current, stepped down by a small transformer. The DC plate supply is obtained from the same source as the current for lighting the UX-199 type tube filaments.

The rectifier is a "bridge" arrangement of four highly efficient electrolytic cells and the output is passed through a filter of unusual quality. As a result of the quality of these two units, and careful design in the receiver itself, the set is remarkably quiet in operation.

The sensitivity of the receiver is good, as is to be expected from a receiver which makes use of three stages of radio-frequency amplification of good design.

Maker: Argus Radio Corporation.



A Receiver That Uses One of the Home-builders' Most Popular Circuits

Name of instrument: Browning - Drake Model 5-R Receiver.

Usage: For the reception of broadcasting.

Outstanding features: Good appearance. High selectivity and sensitivity. Ample volume with fine quality of reproduction. Popular price.

Description: The Browning-Drake receiver has only comparatively recently been available in the form of a manufactured receiver. Heretofore if a radio enthusiast desired to obtain a receiver employing this circuit it was necessary to build the receiver himself or to have it made to order.

In spite of this condition the Browning-Drake circuit became surprisingly popular and as a result of this popularity the receiver was placed on the market as a standard, commercial, broadcast receiver.

(*Continued on page 173*)

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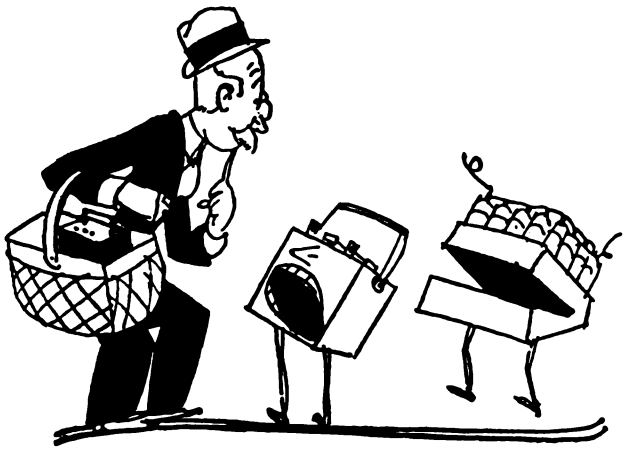

What's power for "A" is power for "B"

—provided, of course, that you use a Rectigon. That's the one best way to keep both "A" and "B" batteries in topnotch form. There's no starving of batteries when you have this home charger to keep them full of pep. And, man alive, the unsuspected power your set shows then! Remember, too, that the bulb used for "B" battery charging is enclosed, like all other parts, in metal, free from harm. And keep in mind that your Rectigon will charge your automobile batteries.

so all batteries are kept lively with

The Westinghouse Rectigon Battery Charger

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No noise as it charges—not a bit of fuss. Not even a murmur that would disturb the mildest slumber.

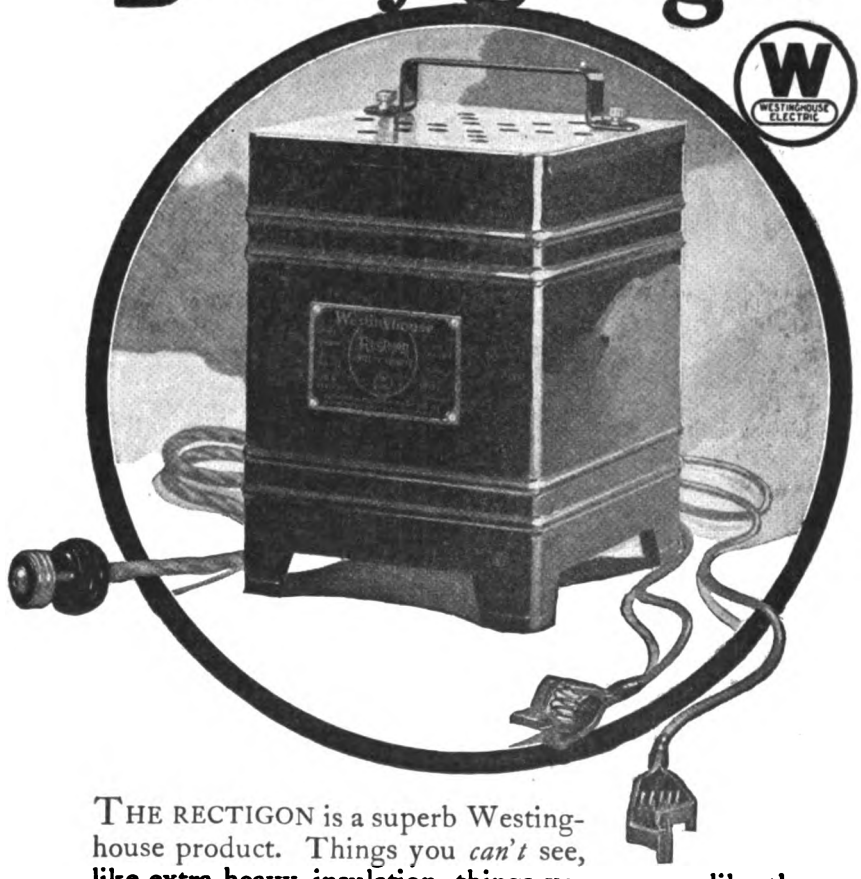
No acids, no chemicals—no moving parts—nothing to spill or burn. No muss, no worry. You'll have no spoiled rugs, no ruined clothing.

Saves its cost in short order—Count the dollars spent in a few trips to the service station and you'll hotfoot it for a Rectigon, for the good it does your pocketbook as well as your batteries.

Snaps on in an instant—Just plug into the light socket, snap on the terminals. Saves service station bother. Spares interruptions caused by absent batteries.

Perfect safety for your set—If you tune in while you're charging there'll be no harm either to set or batteries. Nor will batteries be discharged if anything happens to the current while your Rectigon's attached.

No Storage Battery Radio is Complete Without a Rectigon



THE RECTIGON is a superb Westinghouse product. Things you *can't* see, like extra heavy insulation, things you *can* see, like the durably enameled case—all are of highest quality. Westinghouse also manufactures a complete line of radio instruments, and Micarta panels and tubes.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

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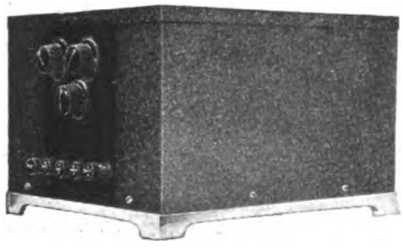
What Built the Reputation of

Mayolian
"B" SUPPLY

The "B" Without a Buzz

?



Type 612
Delivers 40 Mils at 180 volts
All voltages are adjustable
Complete with Raytheon Tube $42.50

PIONEERING in battery elimination, Mayolian was probably the first manufacturer to adopt the now far-famed Raytheon tube as the heart of its B Supply Units, and to earn the approval of Raytheon. From that day to this, each Mayolian has been rigidly held to the standards of the Raytheon and Mayolian laboratories. Years of exhaustive research, extreme precision in manufacture, skilled supervision—all these have contributed to the pre-eminent position of Mayolian.

Today, no matter what make or type of receiver you have, there is a Mayolian to give it a continuous, uniform, noiseless "B" Supply—direct from the nearest light socket, at half the cost of burning a 25-watt lamp.

The Heavy Duty Types of Mayolian employ the new Raytheon B H tube

The nearest dealer will gladly demonstrate in your own home. Write us.

MAYOLIAN RADIO CORPORATION
1668 Webster Ave., New York, N.Y.

Pioneers in Battery Elimination

MEMBER RMA

The Power of Niagara— The Quiet of an Arctic Night

The YES *and* NO MAN

JUST ME.—*Harry Richman* has been "appearing" at WFBH. * * * Yes, he's the same old Harry and still operates that night club at 257 West 57th Street, New York. * * * He is also in George White's new edition of the "Scandals."

MARKO.—Were *Mary Garden* and *Will Rogers* paid for their part in the inaugural program of the National Broadcasting Co? * * * Were they *paid?* You can bet your life they were paid!

BRIGHT EYES.—*Soman*, the WRNY violinist, was at one time a member of the Boston Symphony Orchestra under *Dr. Muck*. * * * No, *Belle Baker* is not to be a regular member of the Eveready staff; there are few regulars on this staff, most of the work being done by guest artists. * * * The WGBS minstrels are broadcast *alternate* Sunday nights. * * * Yes, they are mighty good.

SINCERE.—*Mr. Wad* (WBAL) teaches the piano at the Peabody Conservatory of Music in Baltimore. * * * Are we crazy about the *Royal Heroine?* * * * Yes, she sings well, but we have many other things in life to go crazy over. * * * Sifting the ashes for instance.

SANE BUG.—"*Trade*" is Scrappy Lambert and "*Mark*" is Billy Hillpat in the Smith Brothers period at WEAF. * * * They both come from Rutger's College, where they used to lead the musical activities. * * * No, we had not heard that old *Mark Smith* died in a coughing spasm.

C. D. L.—*Charles D. Isaacson*, studio director of WRNY, was formerly musical critic of the old New York "Mail." * * * *Broughton Hall* writes all of the continuity for WBAL and a very good job he does with most of it. * * * Do we think there should be a school for announcers? Yes, there ought to be *hundreds* of schools for announcers!

DOUBLE S.—Who is the funniest man on the air? * * * There's literally thousands of funny men on the air—but very few of them know it. * * * Seriously, we don't know who *could* be called the funniest man that has been on the air; certainly not *Will Rogers*.

BO-PEEP.—The *Silver-Masked Tenor* is not and never has been a member of the Metropolitan Opera Co. * * * Yes, *Brokenshire* wrote a song, but it fluttered and died, strange as it may seem. * * * *Ralph Wentworth* lives in New Jersey.

FOUR-SQUARE.—Yes, *Sigurd Nilssen* of the Vikings used to be with the Capitol Gang; he is a graduate of Whiteman Conservatory of Music and sang in his debut at Monte Carlo. * * * *Granlund* (NTG of WHN) wrote a book of poetry once; we don't know who published it. * * * Let's see now, it seems as though *Doris Kenyon* collaborated with him.

HARRY B. B.—*Milton Cross* (WJZ) has never written any songs as far as we know. * * * *Edward Husing* of the same staff has written some popular stuff. * * * Was *Keith McLeod* ever associated with WHN? * * * My, no!

JILL WITHOUT JACK.—*Jack Coleman* is the tenor of the WSBF Grand Opera Company. * * * Sure, here's his photo. * * * While we're searching through the files, below is *Allen McQuhae's* photo. * * * Sure send on the two gallons of cider; now who's going to supply the doughnuts?

CHARLES B.—*Hollywood McCosker* is still associated with WOR; he broadcasts very little. * * * However, *Joe Barnett* of that studio aspires to become an opera singer and all of his time outside the studio is spent studying; if his vocal cords show this ambition with him, he shall some day become a great singer.

CURIOUS H.—You're right; *Frances Alda* is the wife of *Gatti-Casazza*, manager of the Metropolitan Opera Co. * * * What makes you think *McNamee* was half "lit" when he announced for the Army-Navy game? * * * We cannot testify as to that, Dear Sir; keep in mind, however, that it was a cold day and "plenty of feeling and no pain" makes one more or less unconscious of the elements.

ALICE - BLUE - GOWN. — *Astrid Fielde* (WJZ) hails from North Dakota, where her father settled after arriving from the Scandinavian Peninsula. * * * She was a childhood friend of *Edward Grieg*. * * * Do we sing tenor or bass? We sing *terrible*.

JAKE.—You lose your hat; *Godfrey Ludlow* doesn't come from Austria but from Australia. * * * *Lucrezia Bori* is Spanish and received much of her musical eddycation in Italy. * * * *Madge Tucker* announces for the WJZ women's hour; she comes to WJZ from the staff of WRC. * * * Yes, *Milton Cross* was actually in *Mary Garden's* apartment when he announced for her in the inaugural National Broadcasting program. * * * You bet your sweet potatoes *Mary Garden* was paid to broadcast.

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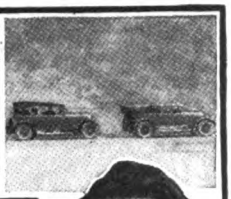
Now Owns a Radio Store

"The Radio business is rushing just now. Building many Super Heterodynes, also doing installation and repairing. To your course I owe all my success in the Radio profession." A. J. Ommodt, Bowman, N. Dak.

Controls First Car by Radio

"I operate the portable broadcasting station in rear car, driving front car by Radio control. Will operate this car from New York to 'Frisco—13 months trip. Then we take the car around the world—a three years' tour. I owe it all to you." Leo Paul, New York City.

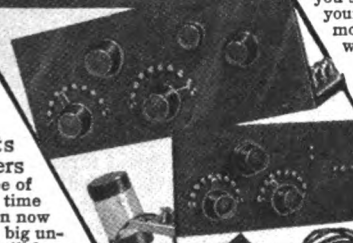


You Can Do What These Men Did!

I Will Train You at Home to Fill a Big-Pay Radio Job

Get into the great new Big-pay Industry—Radio. If you're earning a penny less than $50 a week, clip coupon now. Send for AMAZING FREE BOOK, "Rich Rewards in Radio." Why go along at $25 or $35 or $45 a week, when you could earn $50 to $250 in the same six days, as a Radio Expert? Hundreds of N. R. I. trained men are doing it—why can't you? I'll train you just as I trained them—just as I trained the men whose letters you see on this page. I'll teach you quickly at home in your spare time to be a Radio Expert, and draw down big money for the easiest and most fascinating work in the world.

HERE'S WORK THAT IS ALMOST ROMANCE!



$50 to $250 a Week as a RADIO EXPERT

It's the trained man, the Radio Expert, who gets the big jobs of this profession—paying $75, $100, $200 a week and up. Free book gives all the facts. Every day N.R.I. trained men are taking good places in the Radio field—men like you—men like those whose stories I show you here. You can prepare just as they did by new practical methods, learn right at home in your spare time. Lack of experience no drawback—common schooling all you need. Our tested clear methods make it easy for you. We guarantee to train you successfully. Big Free Book contains all the proof.

These Instruments Given FREE of Extra Cost

All instruments shown here and others sent to all my students free of extra cost under short time special offer. Clip coupon now—find out all about this big unequalled offer while you still have time to take advantage of it. This training is intensely practical—these instruments help you do the practical work.

My Radio Training is the "Famous Course That Pays for Itself"

Make more money quick when you take up this practical course. I show you how to increase your earnings almost from the start of your course through practical pointers I give you.

Howard B. Luce of Friedens, Pa., made $320 in 7 weeks during his spare time. D. H. Suitt of Newport, Ark., writes "While taking the course I earned in spare time work approximately $900." Earl Wright of Omaha reports making $400 in a short time while taking his course—working at Radio in his spare time only! Sylvester Senso, 207 Elm St., Kaukana, Wis., made $500. These records not unusual—these men are a few of hundreds.

And when you graduate, my big Free Employment Department helps you get the job. You get just the same preparation and assistance toward success we gave C. C. Gielow, Chief Operator of the Great Lakes Radio Telegraph Co., E. W. Novy, Chief Operator of Station WRNY, Erle Chambers, Radio Engineer for Stewart-Warner, J. E. Fetzer, Chief Engineer of Station WEMC. The National Radio Institute, established 1914, today offers you the same opportunity these men had under a bond that guarantees you full satisfaction or money refunded. It's your big chance to get into the great Radio field—mail coupon TODAY for my big Free Book and proof!

$70 in one Day for T. M. Wilcox

"I am in business for myself and recently made $70 in one day. I was an electrician of rich experience and was occupying a splendid position as telephone superintendent when I enrolled with your course believing it would open up greater opportunities—have not been disappointed. Estimate that Radio will be worth tens of thousands of dollars to me in the next few years." T. M. Wilcox, Belle Island, Newfoundland.

Read the true stories printed in this border—of men who got out of the rut

Chief Engineer Station WEMC

"Please communicate with my two junior operators here who want to increase their knowledge of Radio. Being a graduate of your course I know they could do nothing better for themselves than study it for it is the way to success in this profession." John E. Fetzer, Chief Engineer, Station WEMC, Berrien Springs, Michigan.

Photo shows Graduate E. F. Spadoni in his own Radio store at Chicago, Ill. "Your course gets the credit," says Spadoni.

Clip Coupon Now for FREE BOOK

Most amazing book on Radio ever written—full of facts and pictures—tells all about the great Radio field, how we prepare you and help you start. You can do what others have done—GET THIS BOOK. Send coupon today—no obligation.

J. E. Smith, Pres.
NATIONAL RADIO INSTITUTE
Dept. B-86
Washington, D. C.

RADIO NEEDS TRAINED MEN!

MAIL THIS NOW!

J. E. Smith, President
NATIONAL RADIO INSTITUTE
Dept. B-86, Washington, D. C.

Dear Mr. Smith: Without obligating me in anyway, send me your free book "Rich Rewards in Radio" and all information about your practical, home-study Radio course.

Name.....Age.....

Street Address.....

Town.....State.....

SEND THIS COUPON

Originators of Radio Home-Study Training

Kimball With WMAQ Chicago

"Accepted a position with the Chicago Daily News Station WMAQ. My income practically doubled, thanks to your fine course. I handle all consultation also do operating." Keith Kimball, Station WMAQ, Chicago, Ill.

Promoted to Big Job

"Just been made Sales Manager of this Radio firm—received a very good increase in pay. Up to present have been getting salary which in 3 months enabled me to purchase a new car.." R. Jones Bay City Mich.

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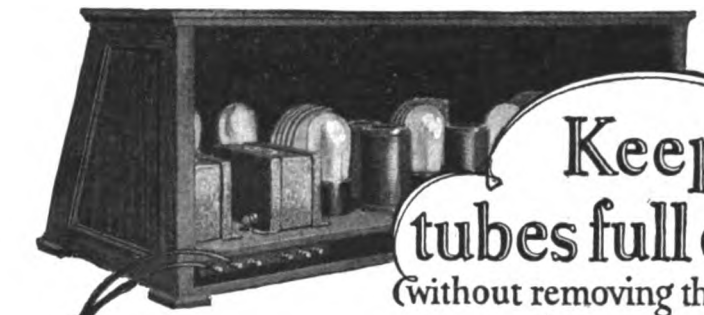
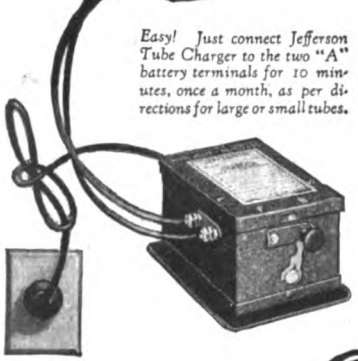


Keep tubes full of 'pep' (without removing them from set)

Easy! Just connect Jefferson Tube Charger to the two "A" battery terminals for 10 minutes, once a month, as per directions for large or small tubes.



TUBES weaken with use, cut down the sensitivity and power of your set, and consume more current. To enjoy top-notch programs every night, keep your tubes always like new.

Once a month, for ten minutes attach a Jefferson Tube Charger to your set. The improved reception—plus longer life of tubes and batteries—are worth many times the small price of $5. Also rejuvenates run-down or paralyzed tubes. Guaranteed, patented and made ONLY by Jefferson. Get one today—from your dealer.

JEFFERSON ELECTRIC MFG. CO.
Largest manufacturers of small transformers
508 So. Green St. Chicago, Ill.

Patented

Jefferson No. 275 Tube Charger

ACME

ENAMELED ANTENNA

Best outdoor antenna you can buy. 7 strands of enameled copper wire; maximum surface for reception. Prevents corrosion and consequent weak signals.

The Original Celatsite

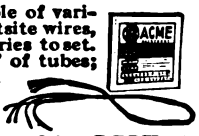
—a tinned, copper bus bar wire with non-inflammable "spaghetti" covering, for hook-ups. 5 colors; 30-inch lengths.
We also offer the highest grade of "spaghetti" tubing for Nos. 10 to 18 wires. 5 colors; 30-inch lengths.

Flexible Celatsite

Flexible, stranded wire for point-to-point and sub-panel wiring. Non-inflammable "spaghetti" covering. In black, yellow, green, red and brown; a color for each circuit. Put up in 25-foot coils.

Celatsite Battery Cable

—a silk-covered cable of varicolored Flexible Celatsite wires, for connecting batteries to set. Prevents "blowing" of tubes; gives your set an orderly appearance.



Send for folder

THE ACME WIRE CO., DEPT. P
NEW HAVEN, CONN.

ACME WIRE
MAKES BETTER RADIO

DESIGNED to OUTLAST World Storage "A" Battery

Two-Year Guarantee Bond in Writing

NEW LOW PRICES

Famous the world over for reliable, enduring performance. Solid Rubber Case lasting protection against acid or leakage.

Approved and Listed as Standard by Leading Authorities

including Radio News Laboratories, Popular Sci. Inst. Standards, Pop. Radio Laboratories, Radio Broadcast Laboratories, Radio in the Home and Lefax, Inc.

Solid Rubber Case Radio Batteries
6-Volt, 100-Amperes $10.00
6-Volt, 120-Amperes $12.00
6-Volt, 140-Amperes $13.00

Solid Rubber Case Auto Batteries
6-Volt, 11-Plate $10.00
6-Volt, 13-Plate $12.00
12-Volt, 7-Plate $14.50

Send No Money

Just state number wanted and we will ship same day order is received, by express C.O.D. Pay expressman after examining batteries. 5% discount for cash with order. Remember, you save 59% on World Batteries—so send your order today.

Set your radio dial at 266.1 meters for the World Storage Battery Station WSBF. Variety—new talent—always interesting. Jerry Sullivan, Dir., and Announcer, "Oh-CAW-go".

WORLD BATTERY COMPANY
Dept. 3
1219 S. Wabash Ave. Chicago, Ill.

WSBF

HARMONY.—The *Gloria Trumpeters* are *Katherine Williams*, *Louise Curer*, *Cora Roberts* and *Mabel Coapman*. * * * You see, they're all ladies. * * * *Westell Gorden* is the new tenor with the Capitol Gang; he's a son of *Westell* the London publisher. * * * *Lucrezia Bori* is a native of Valencia; she made her debut in "Carmen" at the Constanzi. * * * The WEAF Opera Co. is made up of *Frances Sebel*, soprano, *Devora Nadworney*, contralto, *G. di Benedetto*, tenor, *Carl Rollins*, baritone, and *Nino Ruisi*, basso. * * * My, but you're inquisitive; you must do a lot of talking over the back fence!

MAY BEE.—*Scottie Miller* was the WEAF impersonator of *Harry Sander*. "Roamin' in the Gloamin'" has been *Harry Laudered* over the air many times and we're getting in a murderous mood about it; at the best these Scotch dialect songs are much like bagpipe music, and bagpipe music—well, you have to have a very constructive, practical mind to regard it as music at all. * * * We can never get over the notion that bagpipers are playing with a mouth full of beans and molasses and that some of the beans and molasses have in some way or other got down into the vitals of the instrument.

GRANDPAW.—*Gambi* and *Douglas Stanbury* are going with Roxy's new gang; we don't believe that they are married yet. * * * If they are it's a deep purple secret.

SCANDAL-MONGER.—Does *Milton Cross* get paid for his singing with the various advertisers at WJZ? * * * No, he does not get paid for this work; he sings in a Brooklyn church on Sunday.

MAURICE B. H.—*Florence Mulholland* is not appearing on the air just now; she is singing in the choir of the Brick Church at 5th Ave. and 37th St., New York. * * * *Tommy Dowd* is still assistant to *Major Bowes*, and you will always find him working behind the scene during the Sunday night concert.

AMBROSE CHANNEL.—*Teddy Baehr* did the announcing for the World Series from WSBF.

D.S.R.—Paul Ash is a WGN artist who has a wide-awake publicity man. * * * Fame in jazz nowadays amounts to 40 percent radio appearance and 58 percent good publicity; good playing supplies the delinquency. * * * But Paul Ash *can* play.

DANNY.—*Lambdin Kay* is still at the old post. * * * Yes, he's a newspaper man and he's married; his perfect Southern drawl makes him very popular here in the North.

CARL Q.—The National Broadcasting Co. will soon be located at 701 Fifth Avenue., in what will be known as the "National Broadcasting Building."

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Attach this marvelous amplifier to your set in less than 5 minutes

$25 ready to attach

and get the biggest thrill out of radio you have ever had

Any radio set—no matter what type, make, or age—can instantly be transformed to give you such rich and clear and natural reproduction of music and speech that you will be absolutely astounded. You cannot duplicate Truphonic amplification, *no matter how much you can afford to pay.* At the low price of $25, the Truphonic brings a thrilling new enjoyment of radio within the reach of all.

Truphonic Amplification is not surpassed—at any price

If you want this new thrill in radio, do this:

Get the Truphonic amplifier at your radio dealer's. Place it alongside, or behind your set. Make one simple connection to your set. (A clip goes over one prong of the detector tube—done in 10 seconds). Connect the battery cable. Take the regular standard audio tubes from your set. Insert them in the Truphonic, along with an extra tube (either 201A or power tube). Plug loudspeaker into Truphonic. That is all. The rest is a song of praise from you, and from all of your friends who hear it.

The Truphonic employs an audio coupling system that we have found to be definitely superior to transformers, resistance coupling, or impedance. Three stages of this advanced coupling give much greater distortionless volume than is possible by any other method.

A Power tube can be used, and in fact is recommended for the very best results, owing to the fact that for great volume a power tube has a much greater undistorted output capacity than a 201A.

We recommend using a UX171 tube. (The wiring to extra B and C batteries is provided for in the Truphonic cable). This combination gives exceptional volume, with an unapproached faithfulness. But in any case, whether you use a power tube or not, the Truphonic will vastly improve upon your present reproduction.

(Truphonic Amplification is also to be had in single coupler units described on the next page.)

Don't let another night go by without getting all that radio can give in beautiful reproduction. Attach a Truphonic to that set of yours and expect the biggest radio thrill you have ever had.

If your dealer has not yet stocked the Truphonic Amplifier, we will send you one direct C. O. D. on a 5-day money back trial. Be sure to mention your dealer's name and address.

ALDEN MFG. CO., Dept. 319-C, Springfield, Mass.

NA-ALD **TRUPHONIC** NA-ALD

POWER AMPLIFIER

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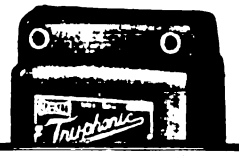
A good name
NA-ALD
in radio



NOT a Transformer

A few points on Truphonic superiority

We make the statement without reservation—that Truphonic amplification not to be confused with impedance is the most perfect audio coupling so far developed. We further state that using the same tubes in a comparison with any other method of coupling, whether transformer, resistance, or impedance, Truphonic affords the most perfect reproduction obtainable in radio—regardless of the price you pay.

These are strong statements—but they hold out to you the promise of the greatest radio enjoyment you have ever had.

This is good news indeed for radio fans and set-builders, as well as for set manufacturers, for today radio value is measured by radio reproduction.

Convincing proof

Here are just a few examples of Truphonic superiority:

With 201-A tubes throughout Truphonic is better than any other method in quality and volume.

With Hi-Mu tubes in the first 2 stages, the volume simply steps up, maintaining the same quality. In fact 2 stages of Truphonic with Hi-Mu tubes at 90 volts will give you greater amplification and quality than two transformers using one 201-A and one 171 Power Tube at 180 volts.

With 199 tubes results are noticeably better with Truphonic and you can go so far as to use four stages of Truphonic with a 120 in the last stage. This of course could not be done satisfactorily with transformers or resistance.

With 199 tubes in the first two stages and a 210 power tube in the last stage results are obtained which could not be duplicated with other coupling methods.

We give this data to show how universal Truphonic is in its use with various tube combinations, giving in every case results superior to all other coupling methods.

Low in price

Every set-maker, whether amateur or commercial, owes it to himself to get full information on Truphonic amplification.

The individual Truphonic Coupler is No. 301 and is priced at $5.00. If your dealer cannot supply, write direct.

The quick attachable Truphonic Amplifier (fully described elsewhere in this issue) consists of 3 stages of Truphonic coupling and the Output Unit.

The Output Unit No. 300, which has the same exterior appearance as the Truphonic Coupler, is designed to protect your speaker from demagnetization and burning out. RCA recommends the use of an output unit with all power tubes. Price $5.00.

ALDEN MANUFACTURING CO.
Dept. 319-C, SPRINGFIELD, MASS.

The Fight Against Distortion

(Continued from page 144)

fully cleaned and dried in a dessicator before assembly. However, the usual cause of trouble in these devices is a dent in the diaphragm which is caused by someone sticking a fingernail on the diaphragm, and which reaches to the back plate causing a short-circuit.

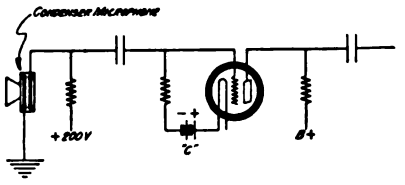
The third type of microphone employed is the electrodynamic type which is used chiefly by the British Broadcasting Company. It consists of a moving coil of thin, light wire which is supported in a strong magnetic field. It is suspended in a rubber cradle which is in turn fastened to a large wooden frame which may be wheeled about.

In passing from the microphone the vibrations, which are now in electrical form, go to an amplifier, in the case of out-of-studio work, a portable one, in which they are strengthened perhaps thousands of times. Figure 1 shows a new model of line amplifier which was recently developed for the Radio Corporation stations and which gives an amplification of several thousand times in fine steps with a noiseless control.

Wire lines are necessary in passing from the outside-of-studio point to the control room. These are either overhead or underground cables. The wires in cables have a certain amount of resistance which is of no great importance and a certain amount of capacity which is very important because the higher the frequency or number of vibrations becomes, the more the vibrating electrical energy passes from one to the other instead of going on to the radio control room. Assuming the energy at 100 cycles to be 100 percent the energy at 10,000 cycles may be as small as 4 or 5 percent.

In other words, 95 percent of the energy which we want transmitted uniformly is lost at the high extreme and very little at the low.

Figure 2 shows the curve of a typical cable. The great distortion present is obvious. Longer or shorter cables cause distortion in proportion although open wire on poles is not nearly as bad, as the wires are separated by a foot or more, thus lowering the total capacity.



A MICROPHONE AMPLIFIER COMBINATION

FIGURE 4: *The use of a condenser microphone with resistance-coupled amplification is shown here diagrammatically.*

Plain electrical resistance decreases the energy but the vibrations retain their exact proportions, so that it is merely necessary to add uniform amplification to bring it up to its original strength.

Various means of correction for capacity losses are employed. Capacity in a circuit causes the current to lead the voltage and inductance causes the current to lag behind the voltage.

Advantage is taken of this fact in placing loading coils in certain telephone cables. These coils give uniform transmission over a fairly wide range, depending on how closely spaced they are. If they could be perfectly distributed such as by placing a minute loading coil in each infinitesimal length of cable, the line would not distort. In practice, they are about 1500 feet apart and give good transmission up to perhaps 2000 cycles. This method is not good enough for a broadcasting circuit, however, and so it is not used.

The method most commonly employed is to shunt down the amplitude of the low frequencies, by means of a network, to the level of the higher ones and to amplify up to the desired level with a flat amplifier. Another method is to construct an amplifier which amplifies the high frequencies as much more than the low as necessary to give uniform output for line plus amplifier. The last two methods require individual adjustment for each line and the latter is especially difficult to adjust exactly.

The vibrations have now arrived in good shape in the control room of the station and from here we will assume they reach the air without further loss.

How to Build Your Own Cone Loudspeaker

In the March issue of POPULAR RADIO, *will appear a constructional article on a 36-inch cone loudspeaker that may be built in less than an hour on the kitchen table for not more than $15.00. Every fan knows that the 36-inch cone-type reproducer brings out the low notes with exceptionally life-like reproduction; here is a chance for you to build a good one in your spare time.*

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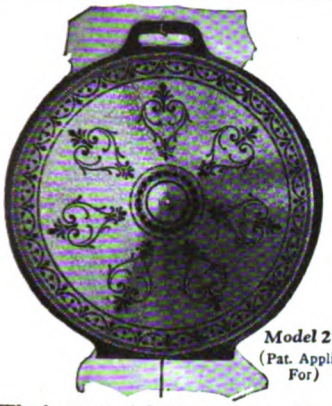
Windsor Wall or Table Type Cone Speaker Amazes Radio World



Model 210
(Pat. Applied For)

The latest model Windsor Cone Loudspeaker has astonished the world of radio. In convenience, quality of reception, and extremely low price, it far surpasses anything yet offered. The cone is 22 inches in diameter and is supported by an easel back. It can be hung up on the wall, as in the picture above, or stood upon any flat surface as shown in the picture below. It contains the famous Windsor loudspeaker unit noted for its extreme clarity and fidelity of reproduction.

Model 210
22-inch Cone Loudspeaker with easel back

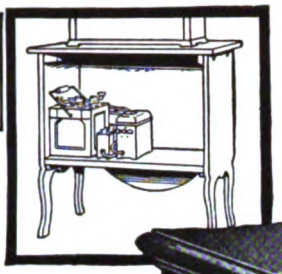
$15.00

(*West of Rockies* $18)
(Pat. Applied For)

Model 302 (Shown below)
With Moulded Composition Horn Loudspeaker and 18-inch Cone Loudspeaker.

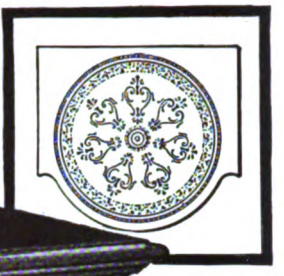
(Pat. Applied For)

In this Windsor Console is combined both the Windsor Moulded Composition Horn Loudspeaker and the 18-in. Windsor Cone Loudspeaker. The top is 30 in. x 17 in. and stands 29 in. high. Plenty of battery and equipment space is provided by large shelf in rear. Price, finished in Mahogany or Walnut $48.00
(*West of Rockies, $55*)



Rear view at left shows large compartment with ample space for batteries, battery charger, or battery eliminator, which are entirely concealed from view. Back is open for ventilation of batteries.

At right is shown the Cone Loudspeaker, with its panel, which is quickly and easily removable, allowing instant access to all batteries, battery charger, battery eliminator or other equipment and wiring.



(Pat. Applied For)

Model 200—*with 22-inch Cone Loudspeaker*

This Windsor Cone Loudspeaker Console is equipped with a 22-inch Windsor Cone Loudspeaker. Its top is 30" x 17" and is 29" high. The battery shelf provides ample space for batteries, charger, battery eliminator and other equipment. Beautifully finished in either Mahogany or Walnut.

Model 200

$29

Console with Cone Loudspeaker Ready for Set and Batteries
(*West of Rockies, $35*)

This is the Fastest Selling Line of *Loudspeakers and Loudspeaker Consoles* in the Radio World Today

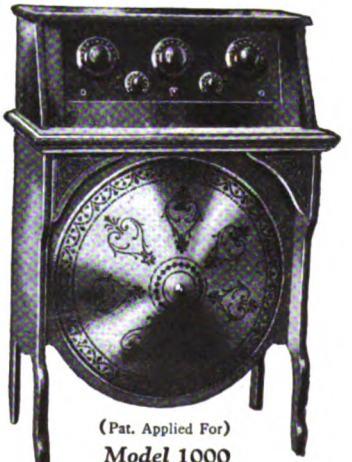
Model 100
with Moulded Composition Horn Loudspeaker or 16-inch Cone Loudspeaker
(Pat. Nov. 18, 1924)

The quality of radio reception made possible by Windsor Cone and Horn Loudspeakers and Loudspeaker Consoles so far surpasses anything heard heretofore that it amazes and delights every radio enthusiast. The Windsor Line is so complete that everyone can find in it a loudspeaker, loudspeaker table, or loudspeaker console exactly to fit their particular needs.

Above is shown a beautiful Windsor Loudspeaker Console, finished in either Walnut or Mahogany, which provides ample space on top for any radio set. The battery shelf beneath will accommodate all necessary equipment. Equipped with either Moulded Composition Horn or 16-inch Cone Loudspeaker. Size: 38 in. x 18 in., and 29 in. high. Price $40.00
(*West of Rockies, $42.50*)

To the right is shown the newest Windsor Loudspeaker Console. It is equipped with a 22-inch Cone Loudspeaker and cabinet suitable for 7-inch radio panels up to 26 inches in length. Battery shelf provides ample space for all equipment. Beautifully finished in either Walnut or Mahogany. Price (without receiving set) . . $44.00
(*West of Rockies, $52.00*)

Note to Dealers: Write or wire today for details of the highly profitable Windsor line.



(Pat. Applied For)
Model 1000
with 22-inch Cone Loudspeaker

Electrical Department

WINDSOR FURNITURE COMPANY

1414 *Carroll Avenue* • CHICAGO, ILLINOIS
Los Angeles Branch—917 Maple Avenue

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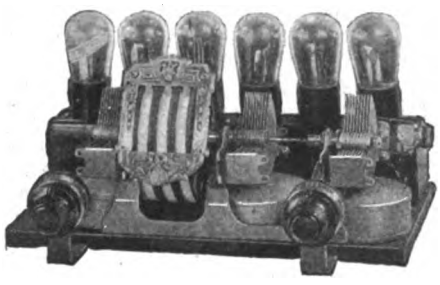
A good name
NA-ALD
in radio

Build this professional set —and know you have the best

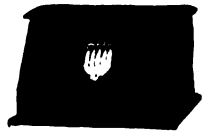


The professional set shown above, for all its compactness, is a giant in performance. And there are two very definite reasons why this set which may be built for less than $40 will out perform sets costing actually *5 times as much!*

TRUPHONIC Amplification

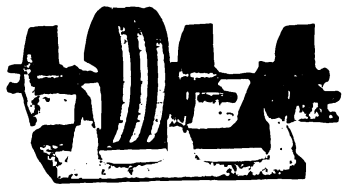
The audio end is the now famous Truphonic amplification (fully described on another page).

Three stages of the superior Truphonic amplification and an output unit to protect your speaker are housed in a steel catacomb. The gang socket panel which neatly covers the catacomb provides for 6 tubes—3 for audio, and 3 for the tuning end of the set. No holes to drill, no apparatus to mount. Can be used in a hundred different circuits. Price 6 tube—$25. 7 tube —$27.



Localized Control Tuning Unit

With the Localized Control Tuning Unit all three condensers can be tuned *together or separately* by the fingers of one hand, giving single dial simplicity with multiple dial efficiency.



When used with shielded coils and the Truphonic Catacomb Assembly you have a set that is ultra professional in efficiency. Rotors grounded to chassis, coil shields grounded to chassis, no grid leads longer than 2 inches, most advanced amplification, output unit—a thoroughly engineered set that you wouldn't trade for a commercial set at 5 times the cost.

Localized Control Tuning Units (including handsome panel plate) are provided in several models. Double (.000375) $8. Double (.0005) $10. Triple (.000375) $10. Quadruple (.000375) $15. Double with Tickler Control (.000375) $10.

If your dealer hasn't the Truphonic Catacomb Assembly and Localized Control Tuning Unit, send to us. Be sure to mention your dealer's name and address.

ALDEN MANUFACTURING CO.
Dept. 319-C Springfield, Mass.

How to Build and Use a Portable Test Board

(*Continued from page 138*)

may be calculated to be .135 milliampere.

With binding post 3 connected to the 67½-volt "B" battery tap, a 5-volt grid-bias change made by reversing switch S3 was found to change the plate current reading from 4 to 8.7 milliamperes or a change of .94 milliampere per change in grid-bias.

Dividing the rate of change of plate current produced by changing the grid-voltage by the rate of change of plate current, produced by changing the plate voltage or .94 by .135, shows an amplification factor of 7.

The DC plate resistance for zero bias may be obtained by dividing the plate voltage by the plate current in amperes or 112½ by .0101—this gives 11,000 ohms. The alternating current plate resistance may be assumed to be .8 of the DC plate resistance for the UX-201-a type tube or 8,900 ohms.

The mutual conductance is equal to the amplification factor divided by the AC plate resistance times one million, when expressed in micromhos, or 790.

How to Construct the Test Board

The schematic diagram, shown in Figure 3, and the top view of the unit shown in Figure 2, will enable any one to locate the component parts of the test board in a convenient position and to wire the board without more detailed information. The exact location of parts is not at all critical and the design may be changed to suit the builder.

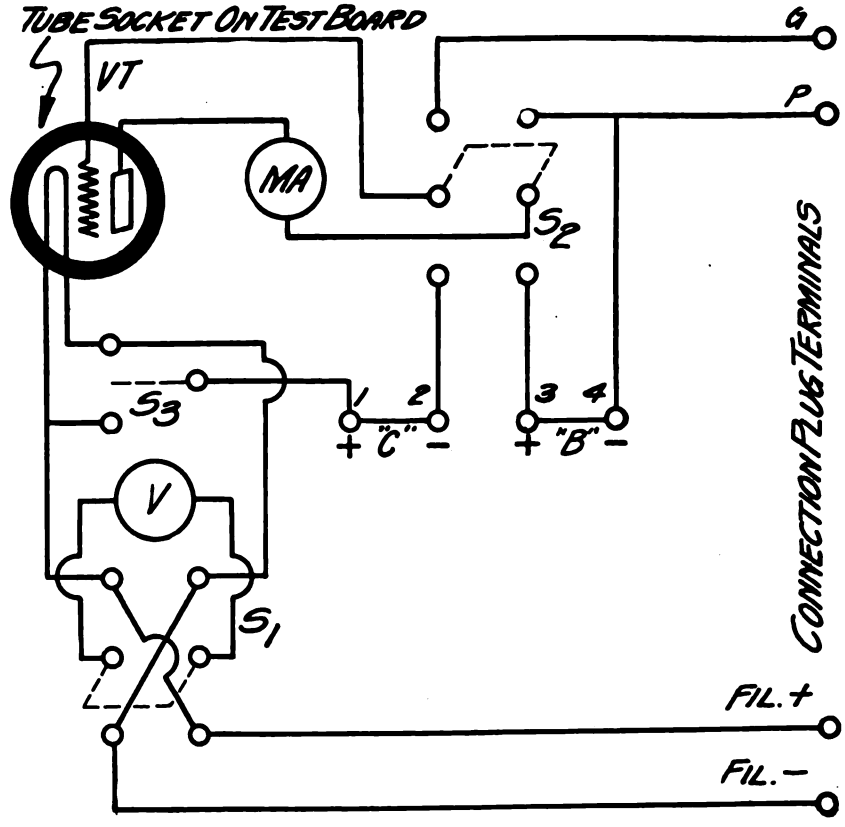
The test board illustrated was made up on a standard, 7 by 14-inch panel with two hardwood supports, 2 inches high, at the ends.

The connection plug was made of the base of an old UX-201-a type tube, the glass being broken out and the cement in the base removed with a knife after heating slightly with the soldering iron. The four wires of the cable were passed down through the prongs of the plug and soldered flush with the ends.

The binding posts on the switches were all removed and long 6/32 brass machine screws were connected in their place and passed down through the panel for convenience in wiring.

A One-tube Set That Will Operate a Loudspeaker

This remarkable receiver—which will be described in full in the March 1927 issue of POPULAR RADIO*—employs only one tube yet it will give as great loudspeaker volume and as good reproduction as most four and five-tube sets.*



HOW TO WIRE THE TEST BOARD

FIGURE 3: *The electrical connections are shown to the vacuum tube switches and the voltmeter and the milliammeter. The four terminals at the right end, in the lamp socket base, are used as a connection plug.*

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30 DAYS FREE IN YOUR HOME

Tested and approved by all of Radio's Highest Authorities

Built like—to look like—and perform like $200 sets

Send Coupon for Amazing Special Offer!

USER-AGENTS! GET OUR

Greatly Reduced Wholesale Prices!

BIG DISCOUNTS to User-Agents who will allow friends to listen to their Miracos.

BEAUTIFUL-BIG-POWERFUL

MIRACO

Retail LIST Price $49.75

GET SPECIAL OFFER

One year GUARANTEE

Real Single Dial Control!

Magnificent Big Powerful Miraco "Unitune" Get Special Offer Amazing Low Price!

The celebrated Miraco Ultra – U.S. Navy type circuit, has also been adapted to Single Dial Tuning—**without sacrifice of selectivity, volume, clearness, power, tone, or distance getting qualities!** In the magnificent big Miraco Unitune—above shown, you turn one vernier knob for stations everywhere. Beautiful hand-rubbed, piano hinged, solid walnut cabinet, 28 in. long, 15 in. deep, 10 in. high. Sloping Bakelite panel is walnut finished to match. Also **offered on 30 days free trial!**

27 in. Long
Solid Walnut Cabinet

Coast to Coast and Foreign Reception Certified by Miraco users

MIRACO RADIO GETS 'EM COAST to COAST

Send for Proof!

Notice! Enormous sales of the celebrated Miraco big fine Receivers (resulting from delighted users so highly endorsing them to friends) again enable us to add hosts of costly new features, latest refinements and up-to-the-minute improvements such as you might expect to find only on much higher priced sets. Miraco's this year are still better—more beautiful—more selective—more powerful for less money than ever before.

Big Powerful New MIRACO

TRADE MARK REGISTERED

USER-AGENTS WANTED - - WRITE!

Reports from users everywhere leave little for us to add. These are only a few of the many in our files and which we receive daily. Send coupon for plenty of additional proof and testimony of nearby users.

Miraco Separates Stations That More Expensive Sets Can't

Logged stations from coast to coast the second evening we had Miraco and got some difficult stations because of so many broadcasting stations coming in under the same number. We can separate them where some of the best receiving sets in the neighborhood cannot. We are well pleased with the set and heartily recommend it. W. J. PETERSON, Seibert, Colorado.

N. Y. Heard Europe

I received six foreign stations during test week: 2LO, OEH, OAX, Lima, Peru, Hamburg, Germany; PTT, Paris, France; SCR, Brussels, Belgium. The Miraco is some set! Local and distant stations come in so loud that you have to shut it down. Had Porto Rico on the loud speaker last week so you could hear it through the whole house. GUS EHRMAN, FULTON, New York.

Beats $200 to $300 Sets in Demonstration

Miraco is the best performer in this town. I have demonstrated against $200 and $300 sets and beat them for distance and quietness.

OREN W. FAWCETT, Saybrook, Illinois.

Experts Say It Can't Be Beat

I am very well pleased with my Miraco. Fact is, it was such a surprise that I haven't gotten over it yet. I have operated sets all over the world for the last seven years. I think that I ought to have some idea of what a broadcast receiver should be. I am sure that you have a set that can't be beat. I logged fifty-six stations first night. A. W. BRYANT, Terre Haute, Ind.

Out Performs Costlier Sets

Like the Miraco very much. The first night I received KFI (Los Angeles), WPG, WHN, CFCF. This is covering from coast to coast; received 47 stations that night, and the next night I received 27 stations. That is more than a lot of sets are doing that cost from 50 to 100 per cent more than mine. It is all you claimed it is and a little more. C. A. MOORE, Van Dyke, Mich.

Alaska Hears Chicago

I am living up here in Alaska one thousand miles from Seattle and it takes a good receiver to pick up any radio in this district, especially near Juneau, our Capital City, which seems to be bothered with electrical currents and static, but the Miraco picked up stations as far as Chicago. I've heard Omaha several times. LESLIE F. PARKER, Gustavus, Alaska.

Finds It Superior to High Priced Set

Miraco is working fine. Have compared it with the (names expensive set) and find it superior in performance. The most pleasing feature of this machine is the counter-balancer. I haven't seen another set with this remarkable feature, and it makes an impression on those who hear and see. WILLIAM KRUMMEL, Mapleton, Iowa.

ULTRA-SELECTIVE LONG DISTANCE RECEIVERS — EASY ON CURRENT

Tremendously increased sales of the beautiful big Miraco's—due to user-agents finding them **unbeatable** among the fine, high-grade sets (even at several times the price!) for razor-edge selectivity combined with extreme long distance reception, clear natural tone, powerful loud speaker volume and economical operation—enable us to GREATLY REDUCE the wholesale prices. Latest, up-to-the-minute models—Sets and accessories! **Get the big new discounts and Amazing Special Offer! Send postal or the coupon today—Now!**

Compare with Any 6 to 8 Tube Sets—

Unless 30 Days' Trial proves your Miraco the most selective, the clearest toned and most powerful distance-getter among sets using up to 8 tubes—**don't buy it!** Enjoy a powerful big Miraco in your home—**at our risk**—and be thoroughly convinced. **Your verdict final**—absolutely no strings to our offer. Satisfaction unconditionally guaranteed.

Operate from Light Socket or Batteries

Miracos are specially adapted and unsurpassed for economical operation with A- and B-light socket power supply units—or with batteries. Power tubes and more than 90 volts of "B" Current may be used, although the power built right into a Miraco makes unnecessary the use of other than regular tubes and 90 volts.

Factory Prices Save You ½! Send Coupon

Save or make a lot of money on sets and accessories by dealing direct with a big, old, reliable manufacturer (7th successful year). Greatly reduced wholesale prices—get User-Agent's Special Offer on Demonstrating Set (no contract to sign, no red-tape). Our offer will AMAZE you. Send Coupon now!

RELIABILITY!

The Midwest organization was one of the very first to engage in the manufacture of radio sets. We consider them to be both morally and financially responsible. They have a reputation for fair and square dealings.—THE PROVIDENT SAVINGS BANK & TRUST CO.

7th Anniversary Special!

Only $19.95 net—an unheard-of price for a high-grade, fully guaranteed 5-tube radio! It's the new $30 (retail list) Miraco **Compact**—14" wide, finished in brown mahogany. Can't be equaled anywhere near the price in quality of construction, selectivity, distance-getting power, tone, ease and economy of operation—**let 30 days' trial prove this!** Complete with high-grade accessories—nothing else to buy—only $49.85 net. Act quick—supply limited. Get Special Offer!

FREE! 30 DAY TRIAL

Another bargain, direct from factory, Coast to Coast range. Powerful, selective, clear, sweet tone.

$19.95

All the Proof you want is waiting for You!

Coupon or postal brings reports from hosts of users in your vicinity and elsewhere proving that Miraco sets **at rock-bottom money-saving factory prices,** outperform sets costing up to four times as much. **You can also buy speakers, tubes, batteries, etc., at big savings from us!** Get our proposition before spending money elsewhere.

Send coupon for Amazing Special Offer!

MIDWEST RADIO CORPORATION
Pioneer Builders of Sets
Cincinnati, O.

479-W Miraco Building

Without obligation, send free literature, testimony of users, AMAZING SPECIAL OFFER and full particulars of your **big money-saving factory-price proposition** on Guaranteed Miraco sets and all radio supplies. ( ) Agent ( ) User ( ) Dealer

NAME

ADDRESS

This Coupon is NOT an Order

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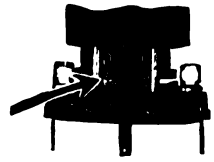
A good name
NA-ALD
in radio

Note this important point



SILENCER SOCKET

There *is* a difference in radio sockets. Any engineer or radio fan of long standing who has had years of experience with Na-ald sockets, and with other sockets, will tell you that—very emphatically.

And now to crown the achievements of the pioneer socket designer and manufacturer comes the nation-wide acceptance of the Na-ald Silencer Socket.

Note how the same continuous strip of phosphor bronze which holds the prongs of the tube in triple-locked, firm embrace and provides connection with the binding posts, gives also the silencing and cushioning effect which renders the tube free from all disturbing michrophonic noises more effectively than does any other socket.

Be sure to get nothing less than the Na-ald Silencer Socket No. 481 XS for the set you build. Owing to great production facilities this socket can be priced at 50c.

Two other Na-ald sockets are the 481 X—similar to the 481 XS but minus the Silencing feature—at 35c, and the 400, the heavy duty De Luxe Socket for the high voltage power tubes, priced at 75c.

Na-ald Sockets are at all good dealers. If out of stock, write to us, mentioning dealer's name and address.

481 XS Silencer Socket

ALDEN MANUFACTURING CO.
Dept. 319-C SPRINGFIELD, MASS.

Potter Condensers

Build the best—

Socket Power Devices
—A and B Supply Devices
Power Amplifiers
Impedance Amplifiers

And are best—

For Filter Uses
Rectifiers
By Pass
Blocking D. C.

American made of best of materials to full capacity. All sizes and types.

POTTER MFG. CO.
North Chicago, Ill.

Potter
BY PASS AND FILTER
Condensers

How to Assemble the All-Amax Senior Three-tube Reflex Receiver

(*Continued from page 150*)

of Figures 4 and 5 in mounting the instruments.

It is advisable to wire the assembled panel and baseboard separately up to the point where it is necessary to connect some part on the panel with another on the baseboard; then the panel may be mounted on the baseboard and the wiring job completed.

Wherever filament wires cross close together it is best to insulate them with spaghetti or covered bus bar. All wiring of the grid and plate circuits should be isolated as much as possible.

It is good practice to solder wherever possible. The writer has formed a habit of using soldering lugs in place of bending the ends of wires into a loop, to be held down by a nut or terminal. The best joints are made by bending the end of the wire to be soldered in an L shape so that this end and the other wire are parallel. The parallel faces thus present a large surface for soldering.

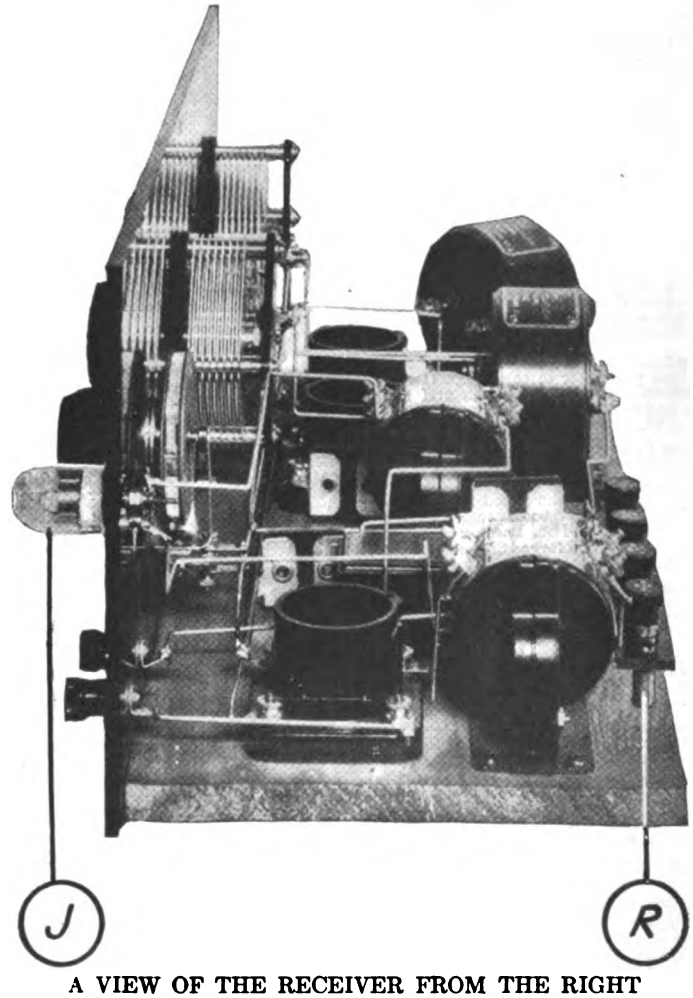
A six volt storage "A" battery is used to supply the filament current. Three 201-a tubes require a total current of slightly less than ¾-ampere per hour. A storage battery with a capacity rating of 100 ampere-hours will therefore operate the filaments well over 100 hours on a single charge.

The high-voltage plate supply for the receiver may be obtained from dry-cell "B" batteries, or from storage "B" batteries; in either case the voltage required is 90. At this voltage the current consumption from the "B" batteries is approximately 11 milliamperes per hour. This means that two "large" size 45-volt blocks of dry-cell "B" battery will provide about 300 hours of service.

The use of a power supply unit in place of the "B" batteries is practicable with this receiver. This is a unit which draws its energy from the alternating current electric light lines and should be one which is provided with terminals to supply 90 volts. There are a number of these units on the market and instructions for building several types have been given in POPULAR RADIO.*

Figure 9 shows how to connect the batteries to this receiver. If a power supply unit is used its negative terminal and the 90-volt terminal are connected

*See POPULAR RADIO for November, 1925, May, 1926, June, 1926, July, 1926, November, 1926 and December, 1926.



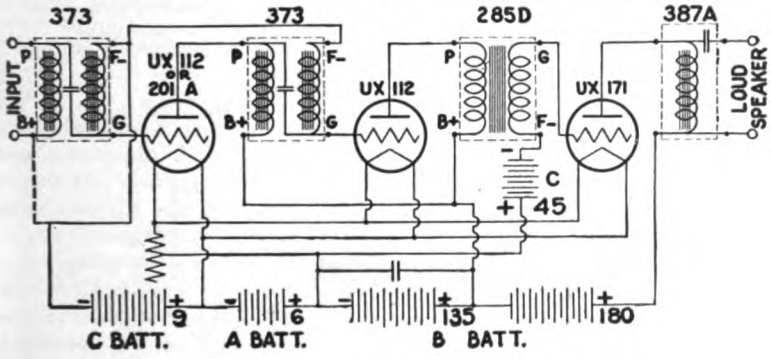
A VIEW OF THE RECEIVER FROM THE RIGHT

FIGURE 8: *Another side view showing the right end of the receiver with the detector mounted on the panel and the binding-post strip and audio transformers mounted on the baseboard.*

A NEW Amplifier Unit

that provides for Extremely Faithful Reproduction

SCHEMATIC DIAGRAM
FOR COMBINATION 2 STAGE DOUBLE IMPEDANCE COUPLED
AND 1 STAGE TRANSFORMER COUPLED AMPLIFIER WITH SPEAKER FILTER



Type 373
Double Impedance Coupler

While the use of double impedances is not new in principle the General Radio Type 373 Double Impedance Coupler is unique in design and performance. To facilitate installation the complete unit, consisting of two impedances and a fixed condenser, is contained within a metal shell. It is connected in precisely the same manner in an audio amplifier circuit as a transformer.

The extent of its range of even amplification is from appreciably below 100 cycles to over 10,000 cycles, with a gradual downward deviation of slightly less than 7% between 100 and 400 cycles. This deviation in an otherwise perfect amplification curve is so slight as to be practically negligible, because the ear of the average individual cannot detect a variation of intensity of much less than 25%.

The amplification curve, in fact, compares favorably with that generally obtained with resistance coupled systems which have the disadvantage of large sacrifices of plate voltages.

The General Radio Double Impedance Couplers have the further advantage that when connected as shown in the above diagram, with one transformer coupled stage, they may be used with a properly designed Plate Supply Unit.

Type 373 Double Impedance Coupler	$6.50
The following parts are used in the General Radio Laboratory Amplifier:	
2—Type 373 Double Impedance Couplers	$13.00
1—Type 285-D Audio Transformer	6.00
1—Type 387-A Speaker Filter	6.00
3—Type 349 UX or CX Sockets	1.50
1—Type 410 or 301 Rheostat 6 ohms	1.25
Complete cost of amplifier parts	$27.75

If your dealer is unable to supply you with any of the above items, we shall be glad to send them to you prepaid upon receipt of list price.

Announcing a NEW Single Hole Mounting Rheostat

The Type 410 rheostats are similar in general appearance and construction to the well known Type 301 rheostat, except that they have the single hole mounting feature, and a flanged knob, with engraved pointer of moulded Bakelite.

Furnished with resistances of 6, 12, and 25 ohms.

Type 410 Rheostat..... $1.25

GENERAL RADIO

Parts and Accessories

GENERAL RADIO COMPANY CAMBRIDGE, MASS.

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A good name
NA-ALD
in radio

Use Power tubes for good quality at full volume

Simply adapt to your set with

Connectoralds
Reg. U. S. Pat. Office

The use of a Power Tube in the last audio will very greatly improve your tone quality. No change in set wiring is necessary when Connectoralds are used.

For UX 171 and UX 112 Tubes, Na-Ald 112 Connectoralds are recommended for maximum volume with storage battery sets. These tubes will deliver without distortion several times the volume of the regular 201A. Price $1.50.

For UX 120 Tubes in UV 201A sockets, the Na-Ald No. 120 Connectorald should be used. To convert a storage battery set to dry batteries with ample loud speaker volume, use a UX 120 tube in the last audio stage with the 120 Connectorald and UX 199 tubes with 419X Adapters in the other sockets. Price $1.25.

For the UX 120 Tube in UV 199 sockets, ample loud speaker volume without distortion is obtainable from any set equipped for UV 199 tubes by means of the UX 120 or equivalent tube, with the Na-Ald No. 920 Connectorald. The tube is raised slightly, but provides for its use in most sets with limited headroom. Price $1.25.

For UX 120 tubes in the UV 199 sockets of the Radiola Superheterodyne Semi-Portable and Radiola Super VIII. These excellent Superheterodynes will deliver ample volume for loud speaker operation when equipped with the UX 120 used with the Na-Ald No. 420 Connectorald. Price $1.25.

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Dept. 319-C Springfield, Mass.

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5 MONTHS FOR $1.00

To double our list of subscribers, we will for a limited time accept $1.00 as payment in full for a five months' subscription for POPULAR RADIO. This offer is open to new subscribers only. Tell your friends about it. They will appreciate this money saving opportunity to secure POPULAR RADIO promptly and regularly each month.

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New York City

Date.....1927.

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627 West 43d Street,
New York City.

Enclosed is remittance of $....., payment in full for subscription order for POPULAR RADIO as checked below.

☐ 5 months for $1.00 (new subscribers only)
☐ 7 months and "How to Build Your Radio Receiver" for $2.00.
☐ 12 months and "How to Build Your Radio Receiver" for $3.00.
☐ 12 months and Set of "Simplified Blueprints" (see page 200) for $3.00.
☐ 24 months for $5.00.

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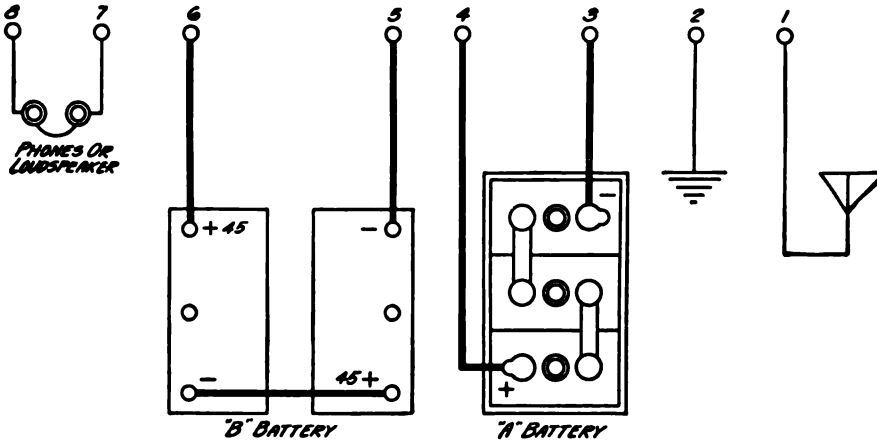
Address.....

City.....State.....



HOW THE BATTERIES SHOULD BE HOOKED UP

FIGURE 9: *The antenna and ground are connected to posts Nos. 1 and 2; the "A" battery is connected to posts 3 and 4 with the positive terminal to post 4. The 90-volts of "B" battery are connected to posts 5 and 6 with the positive terminal to post 6 and the phones or loudspeaker are connected to posts 7 and 8.*

to similar terminals on the receiver, in place of the "B" batteries.

Installing the Receiver

An antenna of from 50 to 125 feet in length is recommended, depending on location. In areas where broadcast stations are numerous the short aerial will provide better selectivity while in more isolated sections a longer antenna, up to 125 feet will provide better volume.

Operation of the Receiver

Before tuning in for stations adjust the crystal detector until the greatest "rush" is heard. Turn the rheostats about half way and rotate the two tuning dials simultaneously, starting from zero. When a station is heard, adjust the djals for maximum volume and readjust the crystal. At this point it is advisable to also adjust the position of the coupling transformer, A, to eliminate interstage coupling.

With the first rheostat, H, turned off and the earphones connected to the set, adjust the coupling by turning the coupler on the baseboard until the least music is heard in the phones. To facilitate this adjustment it is advisable to employ flexible wire for the connections to this coupler. After the proper position has been found bus wire may be substituted for the temporary, flexible wires, because no further adjustment is required.

The Coming of the Radio University

(*Continued from page 130*)

this exceptionally able and fit person.

(3) In classes which involve activity by the children—penmanship, for instance—the teacher who is present in the classroom has an opportunity to observe and correct her pupils at her leisure while the burden of the lesson is being carried by someone else.

It might also be mentioned that lessons thus broadcast are followed by many persons in addition to those in the classroom. It is not at all uncommon for parents, or others who are in no way connected with the schools, to write in and ask whether they may not submit papers for correction, in these radio courses.

In New York City, station WJZ has broadcast recitations by model classes for the benefit of the school children. A particularly good group of children is put through a demonstration before the microphone in arithmetic, English or geography while thousands of others listen in.

A subject which is so important that it well deserves a whole article—or for that matter, a book—to itself, is the educational influence of the radio as regards music. While no statistics are available, it is probable that by this means the number of person-hours, so to speak, of listening to good music has increased not less than 1000 percent in the United States—and by "good music" I mean the best works of the best composers. Today the chances are strong that any child brought up in one of the 5,000,000 homes which are equipped with radio receivers will hear a vast quantity of fine music, well played. Not only does he hear this music, but because of the explanations made by the announcers he knows who are the composers, and something of the theory which lies behind the various compositions.

Indeed, in some cases he may go much further than this. The New York Edison Company broadcasts through station WRNY a series of fine weekly concerts, offering exceptional music played by fine musicians. It mails out to radio listeners a booklet containing the programs for the whole series, and elaborate, carefully written program notes. Anyone

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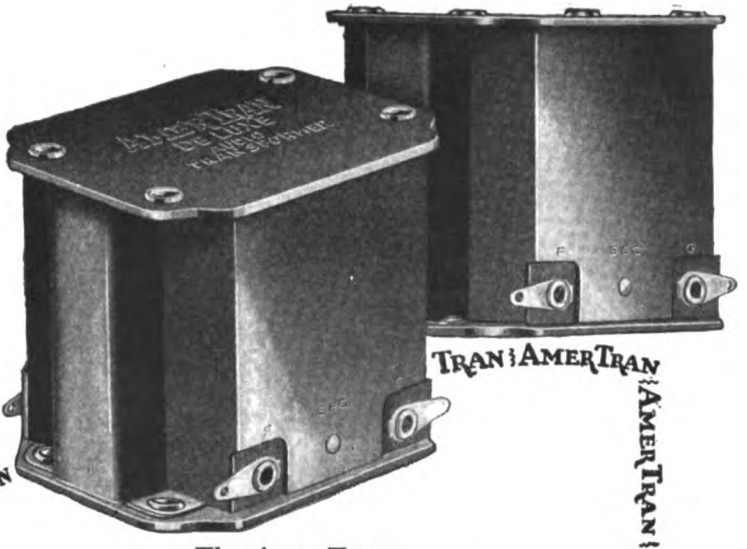
AMERTRAN RADIO PRODUCTS

Sold only by Authorized AmerTran Dealers



The AmerTran De Luxe Audio Transformer Sets a new Standard of excellence in Audio Amplification Made in 2 Types $10.00 Each

For Satisfaction— Buy These Dependable Parts

Audio transformers and power supply units are today the largest selling groups of parts. The American Transformer Company manufactures both. Experience, plus the willingness to make only products that measure up to laboratory standards are responsible for the high efficiency of AmerTran products.

Such parts are worth buying. They out-perform and out-last units less skillfully designed and made. They mean permanent satisfaction. You are not saving money on cheaper radio parts which break, wear out, and even when new cannot come up to the AmerTran standard.

Keep these facts in mind when buying for replacement, for a new circuit or power supply equipment. You will get most value and most enjoyment if your dollars are spent for dependable AmerTran products.

Write for free booklet

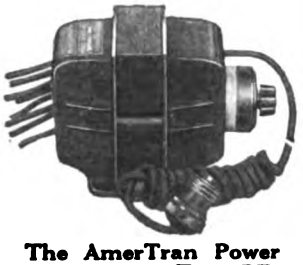
"IMPROVING THE AUDIO AMPLIFIER"

It contains valuable technical data.

American Transformer Company

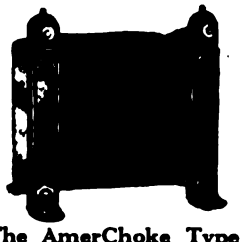
178 Emmet St. Newark, N. J.

"Transformer Builders for over twenty-six years."



The AmerTran Power Transformer Type PF-52

Type PF-52 is intended for use in the better type of power supply developments. It will convert the standard 110 volt, 60 cycle alternating house lighting current to a higher voltage for the plate and lower voltage for filament supply. Price $18.00 Each.



The AmerChoke Type 854

This is a scientifically designed impedance or choke coil of general utility, designed primarily for use in filter circuits. As an output impedance for bypassing direct current from the loud speaker it is both efficient and economical. Price $6.00 Each.

AmerTran Types AF-7 and AF-6

AmerTran Audio Transformers, types AF-7 and AF-6, have been considered for years among the leaders in audio amplification. These popular and efficient models are made in two types—AF-7 (ratio 3½:1)—AF-6 (ratio 5:1). $5.00 Each.

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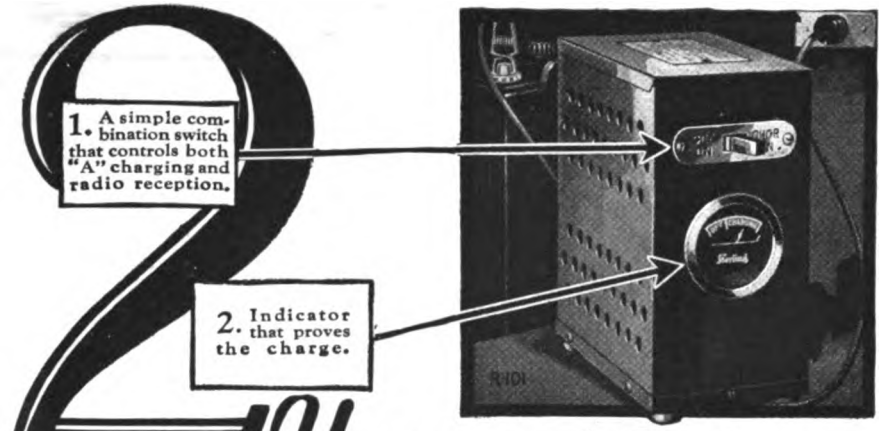
KEEP RADIO UPKEEP DOWN



2 Unusual features of this trickle charger

THE Sterling Trickle Charger, in addition to being automatic, reliable and *absolutely* noiseless, has exclusive features you cannot afford to overlook.

The R-102 Trickle Charger is equipped with an automatic control unit, the master key to the operation of eliminator, battery charging and the set—*automatic control complete!* This means getting the most enjoyment out of your radio with the least attention to your storage "A" Battery.

Made in 2 Models:

R-101, with Combination Switch - - $14.00
R-102, with Automatic Control - - - $17.50

Send for booklet "G" giving complete information on all neccessary caretakers and inspectors of radio

THE STERLING MANUFACTURING CO.
2835 Prospect Ave. - - - - Cleveland, Ohio.

Sterling TRICKLE CHARGER

A good name NA-ALD in radio

Adapters for all tube and socket combinations

Na-Ald Adapters are indispensable to the set owner and set builder who wants a simple and instantaneous means of adapting any particular type of tube to the particular type of socket that is used in his set. For instance, if your set is now equipped with standard 201A sockets, and you want to use the small UV 199 type tube, simply insert the Na-Ald Adapter No. 429 into the 201A socket and insert the 199 tube into the adapter.

No. 419X

The various types of Na-Ald Adapters are given below. Specify them for best results.

For adapting small UX 199 and UX 120 tubes to UV 201A sockets, use Na-Ald Adapter No. 419X. Price 35c.

No. 421X

No. 429

To bring up to date and decidedly improve the Radiola III and IIIA and similar sets employing WD II Tubes, use Na-Ald No. 421X. Price 75c.

For adapting UV 199 tubes to standard 201A sockets use the Na-Ald No. 429 Adapter. Price 75c.

To adapt all UX tubes and UV 201A tubes to UV 199 sockets use Na-Ald Adapter No. 999. Price $1.00.

No. 999

Na-Ald Adapters are sold by all good radio stores and carry the Na-Ald unconditional guarantee.

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Dept. 319-C SPRINGFIELD, MASS.

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The publishers of POPULAR RADIO offer you an opportunity to become their local representative to take care of expiring subscriptions and new subscriptions for POPULAR RADIO and two other popular magazines that they publish.

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All material will be furnished you free of charge and you will be paid an attractive commission and salary.

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who will take the trouble may lay the groundwork for a surprisingly extensive knowledge of good music by following these concerts with the aid of the explanatory material. Sir Walford Davies, Chairman of the National Council of Music of Great Britain, said recently that "Ten minutes' vigorous, clear transmission of great music daily would change the musical taste of the country in ten or fifteen years." His statement is by no means unreasonable.

One of the most striking demonstrations of the power of radio in musical education is now in progress in the state of Connecticut through a cooperation between the State Board of Education and station WTIC, the Travelers' Insurance Company of Hartford. For the first time, a special course in Music Appreciation is now being given by radio for the children of the entire state, and is apparently successful. Fully 100,000 children heard the first lecture-recital in the series and the number is growing. Separate lessons are broadcast for children of all ages, from the primary grades up through high school. Competent speakers explain the significance of various types of music, of which the listeners then hear examples played by a good orchestra, or sung by special vocalists whose abilities and reputation are such that ordinarily it would be impossible to engage them for classroom work. Among the subjects treated in the course, which this year embraces twenty lessons, are folk music, the music of the great composers, music for special occasions such as Christmas, elementary music forms, rhythmical and harmonic studies, and the evolution of musical instruments.

THE ROSTRUM OF THE NEW "RADIO COLLEGE"

In a single course of instruction by radio the University of Minnesota has enrolled 2,300 students, scattered in 26 states. These courses are supplemented by outside reading. Above, Prof. A. E. Jenks is shown broadcasting a lecture on anthropology from station WCCO.

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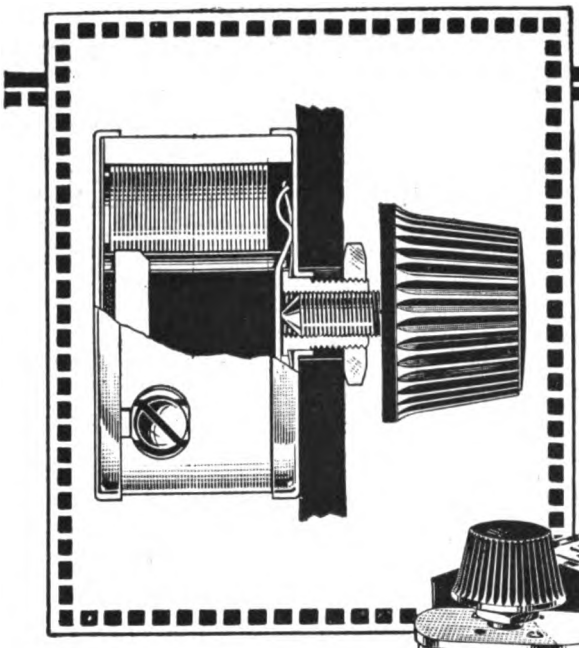
What could be more striking than the thought of one or two hundred thousand students, in every town in Connecticut, and even in other nearby states, in schools of every type from vast temples in large cities down to the little schoolhouse at the crossroads, all listening at once to a lesson given over the radio!

And music, of course, is only one of many subjects which are appropriate for such treatment. Think, for example, of the new impetus which could be given to the study of geography if Lieut. Commander Byrd, on returning from his successful flight over the North Pole, could have described his experiences to the school children of Connecticut—or for that matter, of the whole United States. Why should not courses in government have the benefit of addresses by members of the President's Cabinet? Or students of history hear Pershing explain the American strategy in France?

Perhaps the most striking of all the experiments in education *via* radio is that which the government of Haiti is at present attempting. Most of the Haitians live in mountainous, inaccessible country; they are very poor; and nine out of every ten are unable to read or write. At the same time there are many things which the government wants to tell them. They are particularly in need of instruction in personal hygiene, sanitation, and in important facts about agriculture, by means of which nearly all of them earn their living. I am advised by Mr. W. W. Cumberland, in charge of this work for the Haitian government, that receiving sets equipped with loudspeakers are being installed in all the villages large enough to make it worth while. Thereafter the government from its own broadcasting station, HHK, will tell the Haitians what they need to know. Not only will useful information of the sort mentioned above be given, but new laws and regulations will be announced and explained, and news of miscellaneous government activities be broadcast. In fact, the radio will serve the Haitians as the daily press does in other countries where the percentage of literacy is higher.

A similar development is being worked out in Mexico, where the Calles government is confronted by the same problem of a large illiterate population which can be reached in no other way. Incidentally, one wonders what these ignorant and superstitious villagers will make of the wonderful box which speaks with the voice of a man! Will they not be tempted to incorporate into their religious ceremonies worship of the receiving set as a new and highly effective variety of black magic?

I could go on almost indefinitely describing the educational uses of the radio, but space forbids. I can only mention, for example, the new interdominion broadcasting scheme of the British through which every part of the



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This new oversize resistor is used as standard equipment by leading B-Eliminator manufacturers such as Acme, All-American, Majestic, Philadelphia Storage Battery and Willard. The scientifically-treated discs provide stepless, noiseless, plate voltage control, and the setting will be maintained indefinitely.

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ALLEN-BRADLEY research engineers have developed a series of variable and fixed resistors especially suited for B-Eliminator hookups. The success of their efforts is indicated by the fact that Allen-Bradley resistors, both variable and fixed, are used by more than fifteen B-Eliminator manufacturers, including European as well as the largest American manufacturers.

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PERFECT FIXED RESISTOR

Another triumph of the Allen-Bradley Research Laboratory is Bradleyunit-A, a perfect fixed resistor that contains no glass, requires no hermetic sealing, and can be soldered into place without the use of clip mountings. Bradleyunit-A is not affected by temperature or moisture.

The silent, smooth control of plate voltage so essential in B-Eliminator service is obtained with Bradleyohm-E. For fixed step adjustment of voltage, Bradleyunit-A is recommended.

Do not experiment with make-shift resistors when these Allen-Bradley units have been pronounced the ideal units for B-Eliminator service.

Ask your dealer for them, today!

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GLENN H. BROWNING, Laurence M. Cockaday, Gerald M. Best and many other eminent radio designers use the Lynch Metallized Resistor in their experimental circuits and receivers. These men *know* radio; they have laboratory and testing equipment with which quickly to make accurate comparisons. There could be no better proof of the true merit of the Lynch Metallized Resistor than the endorsement of these experts.

Comprising a concentrated metallized deposit one-thousandth of an inch thick upon a rigid core, sealed forever within a glass tube, the Lynch Metallized Resistor gives *conductive*, non-arcing resistance that remains silent, accurate!

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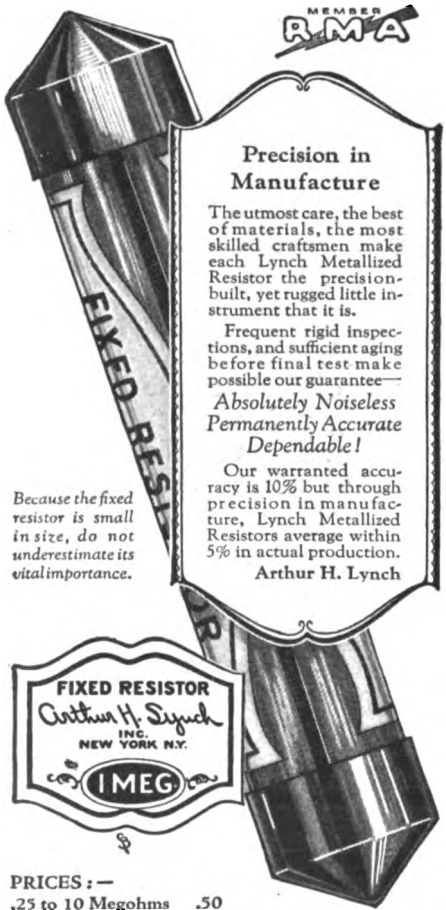

Because the fixed resistor is small in size, do not underestimate its vital importance.

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The utmost care, the best of materials, the most skilled craftsmen make each Lynch Metallized Resistor the precision-built, yet rugged little instrument that it is.

Frequent rigid inspections, and sufficient aging before final test make possible our guarantee—

Absolutely Noiseless
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Dependable!

Our warranted accuracy is 10% but through precision in manufacture, Lynch Metallized Resistors average within 5% in actual production.

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PRICES:—

.25 to 10 Megohms	.50		
above .01 to .24 "	.75	Single Mounting	.35
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LYNCH METALLIZED FIXED RESISTORS

Empire will be linked up. Speeches delivered in London or at any of seven other points will be rebroadcast in every dominion simultaneously, and special "Round the Empire" programs will be given in which India, Australia, South Africa, etc., will take part in turn with characteristic native music and with addresses by representatives. These programs will reach 400,000,000 inhabitants of the Empire and 100,000,000 other persons—assuming that they all have receiving sets, and in a few more years that assumption will by no means be fantastic.

I should perhaps sound a note of warning, lest what I have written should give to some of my readers an exaggerated idea of what is possible. Up to the present, it is true, education by radio has not been used to give a thorough and advanced knowledge of any subject. The aim is to give the listeners what they want; and by experimentation it is found that they prefer short lectures, not many on any one subject, and a rather light and popular style of treatment. Thus far, radio education for adults, has been in character and content about equal to Chautauqua lectures or the average speech before the average Woman's Club. Such material is not a substitute for hard, solitary study. It is certainly not a substitute for classroom work, since 90 percent of the useful things a pupil learns he gets from his fellow students—and they have no connection with the formal subject of instruction. Teaching by radio bears little relation to that most difficult of all tasks, stimulating the individual to think for himself.

On the other hand, some of these objections are due to the newness of the whole idea, and may be remedied with time. Experts in pedagogy have as yet paid no attention to the art of radio teaching. No technique has been worked out; no special textbooks have been written to accompany lectures over the air. No attempt has been made, for example, to link the showing of an educational motion picture film with broadcasting of an accompanying address. There is reason to believe that when these questions are studied great progress will ensue.

Most important of all, the radio is destined to break down the artificial barriers which at present surround "education" and make it a thing only for the young, to be laid aside forever as soon as maturity has been reached. Most of the experiments I have been describing are intended to reach adults; this is as it should be. For after all, education is a part of growth, and when growth stops, decay begins.

When we try to envisage the future in these new terms, a fascinating prospect unrolls itself. I shall not attempt to discuss it here, however, since it deserves and indeed demands separate treatment in another article.

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World Radio
Storage "B" Battery
12 Cell—24 Volt
2.75

Proved value. Thousands of users find reception almost magical. Clear, true power—instantly and unendingly. Wise economy. Sturdy construction—*Solid Rubber Case* protection. Recharged for almost nothing. Endorsed and listed as standard by famous Radio institutions including Pop. Radio Laboratories, Pop. Sci. Inst. Standards, Radio News Lab., Lefax. Inc., and other Radio authorities. What more need be said? *Extra Offer: 4 Batteries in series (96 volts) $10.50.*

Send No Money Just state number wanted and we will ship same day order is received, by express C. O. D. Pay expressman after examining batteries. 5% discount for cash with order. Remember — you save 50% on World Batteries, so send order to-day.

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Makers of the Famous World Radio "A" Storage Battery
Prices: 6-volt, 100 Amp. $10.00; 120 Amp. $12.50; 140 Amp. $15.00.
All equipped with Solid Rubber Case.

Set your radio dials at 288.3 meters for the World Storage Battery Station WSBC, Variety-New Talent-Always Interesting; JERRY SULLIVAN—Director and Announcer—"Oh-CAW-go"

YAXLEY
APPROVED RADIO PRODUCTS

Radio Convenience Outlets

Know greater radio enjoyment. Install a Yaxley Radio Convenience Outlet for loud speaker and phone connection in every room. Consists of wall plate and wall socket jack with screw terminals. Fits any standard switch box. Easily wired. Wiring diagrams in each package.

No. 135 As described above.....	Each	$1.00
No. 137 With Plug, for battery connections.....	"	2.50
No. 136 For aerial and ground...	"	1.00

Automatic Power Control

Takes care of your B eliminator or trickle charger or both. Turn the set on—the trickle charger is off, the B eliminator is on, and the reverse when the set is turned off.

No. 444 Series Type for sets having tubes with a current draw equal to or greater than 6 U. V.-199 types of tubes ..... Each $5.00

Also makers of Famous Air-Cooled Rheostat, Jacks, Jack-Switches, Cable Connector Plugs, etc.

At your dealer's. If he cannot supply you send his name with your order to

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What's New in Radio

(*Continued from page 156*)

The receiver employs five tubes and consists of one stage of tuned high-frequency (radio-frequency) amplification, a regenerative detector and three stages of resistance-coupled low-frequency (audio-frequency) amplification. The tube employed in the high-frequency amplifier is a UX-199 type tube. The other four tubes may be the UX-201-a type, or they may be UX-199 type tubes if the use of a storage battery is impractical for any reason. It is advisable to use a power tube in the last low-frequency stage. Where UX-199 type tubes are used in the first four sockets a UX-120 type power tube may be used in the last stage. Either a UX-171 or a UX-112 tube may be used for the power stage if UX-201-a type tubes are used in the second, third and fourth sockets. In any event, the UX-199 type tube must be used in the high-frequency amplifier stage.

In spite of the fact that this receiver includes only one stage of high-frequency amplification, and contains only two tuned circuits, the sensitivity and the selectivity of the receiver are really remarkable.

The operation of the receiver is simple. There are two tuning controls but the adjustment of one of these controls is not critical. As a result the adjustment of this latter control, in tuning in a given station, need only be approximate, while the exact tuning is accomplished by means of a second control. This is true in reception from local and semi-distant stations. In reception of weak signals from distant stations both of the controls require accurate adjustment.

There is a volume control included on the panel of the receiver which provides a gradual control of volume, from maximum down to practically zero. In addition there are two knobs by means of which the filament current from the "A" battery is controlled. These two knobs require only an initial adjustment.

A filament switch is also provided on the panel to turn the receiver "on" and "off." The last two items on the panel are the jacks; one for plugging in a reproducer unit and the other for use with headphones.

The pleasing appearance of the receiver is obtained through the use of a cabinet finished in two-tone mahogany. The front panel and the control knobs are of polished black bakelite; all engraving is done in gold.

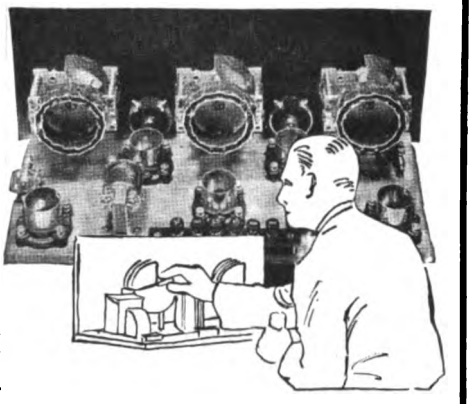
The battery requirements of the receiver will depend upon the type of tubes used. The normal tube equipment, where a storage "A" battery is used, consists of a single UX-199 type tube, three UX-201-a type tube and a UX-112 type power tube. With this tube equipment a 6-volt storage battery is used for the filament supply; for the plate supply a "B" battery potential of 135 volts is sufficient for normal use.

If extreme volume is desired, however, the "B" battery potential may be increased to 180 volts. The "C" battery consists of two of the small 4.5-volt "C" battery blocks.

The receiver will operate with almost any kind of antenna. If an indoor antenna is used it should be about 40 feet in length, while an outdoor antenna should be from 50 to 100 feet in length.

Maker: Browning-Drake Corporation.

$75 A WEEK BUILDING RADIO SETS
—*in your spare time*



JOIN the Radio Association of America. Learn how to build and repair radio sets. The Association will train you—start you out in business if you wish. Be the radio "doctor" of your community. $3 an hour upwards easily made. Radio offers you a big money-making opportunity right now.

Earns $500 in Spare Hours

"I have at last found myself," writes Lyle Follick, Lansing, Michigan, "I have already made over $500 building radio sets after working hours." Werner Eichler, Rochester, N. Y., writes, "I have made over $50 a week in my spare time."

Our members are starting radio stores, increasing their salaries, securing better positions, passing radio operator examinations, earning big money for the most enjoyable kind of spare-time work.

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You're taught how to build and repair all kinds of sets. You're given the training you need in preparing for a Licensed Radio Operator's examination. You receive the privilege of buying parts at wholesale prices.

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If you're interested in Radio for either pleasure or profit, join the Association without delay, because we have a plan whereby your membership may not—need not—cost you a cent. Only a limited number of these memberships are acceptable. Write now for details. Write before it's too late.

This Association has prepared a beautiful book that gives figure-facts regarding the profit possibilities of the Radio Industry, the purpose of the Association, and the details of the Special Membership Plan.

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The Perfect Ground

Marvelous newly invented ground gives greatly improved reception. Increases power and distance, users say. Thousands getting results like D. S. Friedman, Radio Engineer of Burlington, Iowa, who writes, "Am very much pleased with way your Ground Hog operates. Am now able to tune in any good stations with *little trouble from static.*" Everyone pleased and delighted. Users report, "Leaks stopped," "Static reduced." "end to jangling even in midsummer," "Results never dreamed of." Absolute satisfaction guaranteed or *money back* at once.

Efficiency Always Insured

Only ground on market that has power to draw and hold moisture thus assuring maximum efficiency at all times. Holds moisture indefinitely. Highly sensitive to radio energy. Proven valuable aid to clear, powerful distance reception.

SEND NO MONEY

Every radio owner needs a Yale Ground Hog. To introduce, we offer to those who act at once, regular $5.00 size for only $2.00. Send name today and pay postman $2.00 plus 17c. postage on delivery, or send only $2.00 with order and save postage.

Highest Approval

Tested and approved by Popular Radio Laboratory and other high scientific radio authorities. You can order direct today with absolute confidence of value and satisfaction.

FREE—Complete description of Ground Hog, proof of user satisfaction and full details of amazing special offer free on request—Send name today.

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Announcing

the first of a series of new models of

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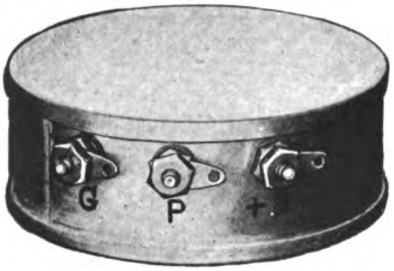

Shielded Tuned Radio Transformer, No. 30

SICKLES

Diamond-Weave Coils

The new Sickles Shielded Tuned Radio Transformer prevents both outside and local interference. It is remarkably compact, sharp-tuning, sturdy.

Sickles Diamond-Weave Coils have established an enviable reputation for low distributed capacity, low dielectric losses, and large range of frequency with small variable capacity.

The ideal coil for the Na-Ald Localized Control Tuning Unit and the Na-Ald Truphonic Assembly.

There are Sickles Diamond-Weave Coils for all leading circuits.

THE F. W. SICKLES CO.
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No.	Coil Prices	
30	Shielded Transformer	$2.00 each
24	Browning Drake	7.50 set
18A	Roberts Circuit	8.00 set
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Reception *Not Deception*

Volume, not noise.
Tone, not blare.
Clear, mellow, perfect reception of every sound from a whisper to a full orchestra.
That's what radio enthusiasts everywhere are enjoying with the new Dulce-Tone, the perfected radio-talking-machine-speaker.
Dulce-Tone, for $10, and your phonograph make the finest loud speaker money can buy. Try it and see. Your money back if you're not completely satisfied. At your dealers, or send the coupon.

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Formerly named, The General Phonograph Mfg. Co.
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Enclosed is $10 for my Dulce-Tone. If I'm not satisfied after 10 days' trial, I'll return it and get my money back.

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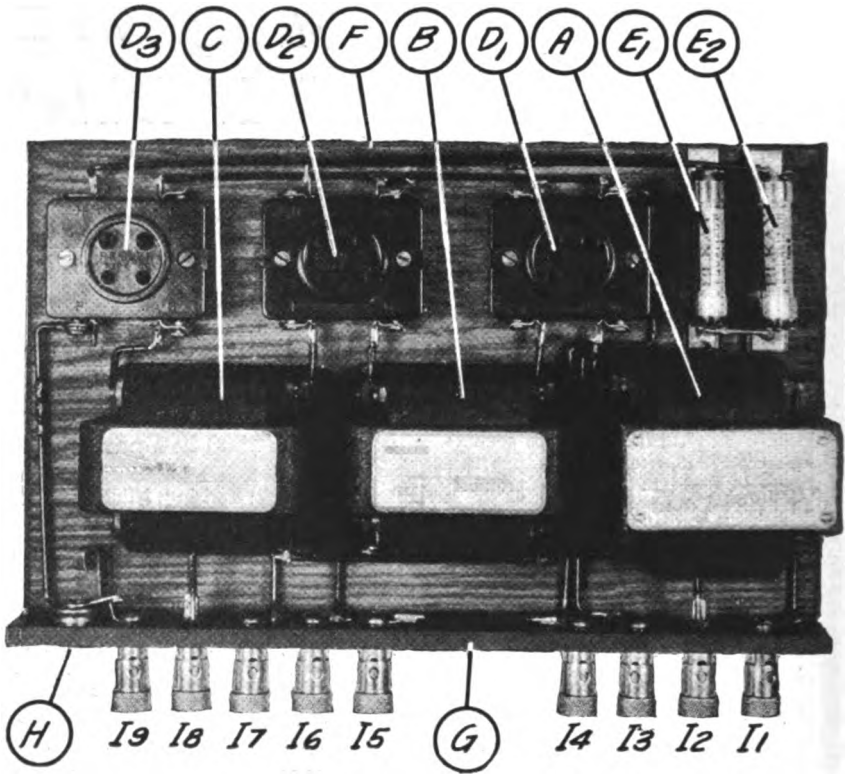
How to Get Quality Amplification

(Continued from page 131)



HOW THE AMPLIFIER LOOKS FROM ABOVE

FIGURE 4: *This picture shows the arrangement of the parts and the general appearance of the amplifier when completed.*

tested with a number of receiving sets.

The schematic wiring diagram for this unit is shown in Figure 1.

How to Construct the Unit

To construct the unit, cut the baseboard, F, to the proper size, as shown in Figure 3. Then, prepare the binding-post strip, G, and attach the nine binding posts, I1, I2, I3, I4, I5, I6, I7, I8 and I9, as shown in Figure 4 and the jack, H.

Now, fasten the binding-post strip, G, by means of three screws to one of the long sides of the baseboard, F, and you are ready to mount the instruments on the baseboard.

Mount the three amplifying units, A, B and C in their proper positions and fasten them down to the baseboard with short, strong, round-head wood screws.

Next, fasten down the three sockets, D1, D2 and D3 using two thin, flat-head, wood screws to each instrument. Then, mount the two automatic filament control mountings and insert the two controls, E1 and E2.

The wiring should be done exactly as shown in Figure 3; this carries out the wiring scheme given in Figure 2. When the wiring is completed, the instrument is ready to be installed.

In Figure 1 is shown the manner of connecting to the detector and to the batteries that are to be used with the amplifier.

Insert two UX-201-a type tubes in the first two sockets, D1 and D2, and insert a UX-171 type tube in the last socket, D3.

The amplifier is now ready for use and a loudspeaker that is capable of reproducing high-quality signals should be inserted, by means of a plug, in the jack, H.

The receiver that this unit is used with should be tuned in the usual manner and the quality of reproduction will be found to be excellent even when the enormous volume that the unit is capable of producing is used.

The list of parts given on page 131 includes the exact instruments used in the unit from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by POPULAR RADIO *which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model amplifiers,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

TOBE

Trade Mark Reg. U. S. Pat. Office

RADIO INTERFERENCE FILTER No. 1

Actual Size

TINYTOBES

A new TOBE product making the TOBE line complete, from the smallest to the largest fixed condensers required in Radio.

TINYTOBES are specified in the Lincoln Superhet., Victoreen, Sampson T. C., and many other leading circuits.

It would be hard to find a more efficient, compact and generally advantageous small fixed condenser than the TINYTOBE.

PRICES

	Each
.0001 Mfd. to .00025 Mfd., .0005 Mfd.	35c
.001 Mfd. and .002 Mfd.	40c
.005 and .006 Mfd.	45c
.01 Mfd.	55c
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No condensers of this kind are genuine unless they bear the trade-mark name TINYTOBE. Accept no substitutes.

The TOBE 600 Line

High-voltage condensers for AmerTran and similar high-voltage packs. Big, husky 1000-volt D. C. continuous-operating voltage condensers—made to stand the gaff. Equipped with TOBE safety terminals.

PRICES

5 Mfd	$1.75
1.0 Mfd	2.50
2.0 Mfd	4.00
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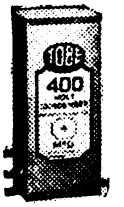
TOBE Filter Condensers

The standard for general radio use, for all operating voltages up to 300 volts D. C. Used by Philco, National Company, General Radio Company, King Radio, and many other leading manufacturers.

THIS new and effective filter unit is designed for the reduction of annoying Radio-Interference, caused by household motors of the D.C. or universal types, on oil burners, refrigerators, elevators and dumb waiters, washing machines, etc. It may also be applied to vibrator motors, etc., and will, in most cases, reduce the interference to a point where it is no longer noticeable. It is designed to be attached directly to the offending appliance, *not* to the Radio set. Strongly cased in a grounded metal container, with lugs for attachment to floor or base plate, provided with 5 flexible leads, for immediate attachment, and with wiring-diagram directly on label. Once installed, requires no attention or adjustments. Designed by Sewall Cabot, noted Radio engineer, and carrying the TOBE trademark.

Write us for descriptive pamphlet L-2 on TOBE INTERFERENCE FILTER No. 1. The list price is $15.00, and if your dealer is not already supplied, we will gladly fill your order direct on receipt of your check or money order.



The TOBE 400 Line

Specially cased condensers for 400-volts D. C. operating voltage. For use with Raytheon BH and similar high-voltage rectifying tubes in B-Eliminators. Use short-path type-condensers and equipped with unique TOBE safety terminals at base of can

PRICES

1 Mfd	$2.00
2 Mfd	2.75
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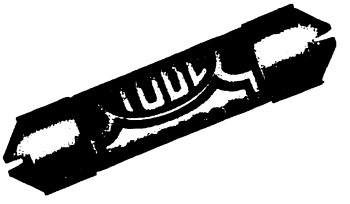
This 4 mfd. TOBE Condenser—working voltage 250—has been specially designed for construction of power tube output filters, now so generally required between the power tube plate of a Radio set and the speaker—for protection of speaker windings. Price $3.50.



The TOBE Veritas HI-Current Resistor

A special and unexcelled resistor, capable of radiating 4 to 5 watts continuously without change or deterioration. Made to be soldered directly into the circuits without the use of clips, although of standard length, so that standard mounts may be used if desired.

Prices	Each
2,000, 3,000, 5,000 7,500, and 10,000 ohms	$1.10
50,000 ohms	.90
.1 meg	80
½, ¼ and 1 meg	.75

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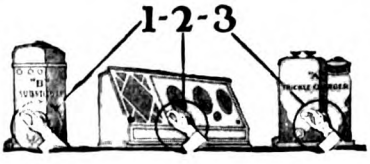
Google

The Old Way

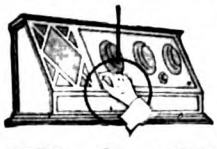
each time you turned your set on or off you had to operate

3 Switches



NOW—

you operate everything with **ONE** *switch—the* **SET SWITCH**



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DOES IT

—AUTOMATICALLY

Manufactured by the Makers of the Famous BRACH LIGHTNING ARRESTERS

L. S. BRACH Mfg. Co.
NEWARK, N. J.
TORONTO, CAN.

WHAT READERS ASK

CONDUCTED BY DAVID LAY

IN *justice to our regular subscribers a nominal fee of $1.00 per question is charged to non-subscribers to cover the cost of this service, and this sum must be inclosed with the letter of inquiry. Subscribers' inquiries should be limited to one question or one subject.*

What Is the Proper Size Tuning Condenser for a Short-wave Receiver?

QUESTION: I am planning the construction of a receiver to cover the short-wave bands between 30 and 200 meters, but I do not seem to be able to find any really authentic information as to the proper size for the tuning condensers to be used in such a circuit. The circuit that I have selected is the shunt-feed Hartley circuit and I am planning to use plug-in coils that I expect to make myself. I realize that if I use a very small tuning capacity I shall have to make quite a few coils to cover this waveband; but I am willing to do this. What I want is an arrangement which will enable me to spread the stations well out over the dial instead of having them all crowded in together as they are on most short-wave receivers that I have heard in operation.

—FRED STEWART

ANSWER: In the shunt-feed Hartley circuit there is only one tuning condenser; the other condenser is used to control regeneration and may be a standard 250 micro-microfarad (.00025 mfd.) receiving condenser. It is immaterial whether this latter condenser is straight-line-capacity, straight-line-wavelength or straight-line-frequency; the selection of the tuning condenser, however, is most important.

In the writer's short-wave receiver, the tuning condenser has a maximum capacity of approximately 40 micro-microfarads (.00004 mfd.). This size was selected, after extensive tests, as the most practical size for the purpose. Using this condenser, seven coils in all are required to cover the waveband you mention. The wavelength range of each coil slightly overlaps the wavelength range of the next smaller and the next larger coils so that the band from 27.7 meters to 225 meters is completely covered.

Even with such a low-capacity tuning condenser as this there is some crowding at the lowest wavelengths; but if a high ratio vernier dial is used with this condenser there is *no overcrowding* and the tuning becomes quite simple.

The tuning condenser should have an approximate straight-line-frequency characteristic.

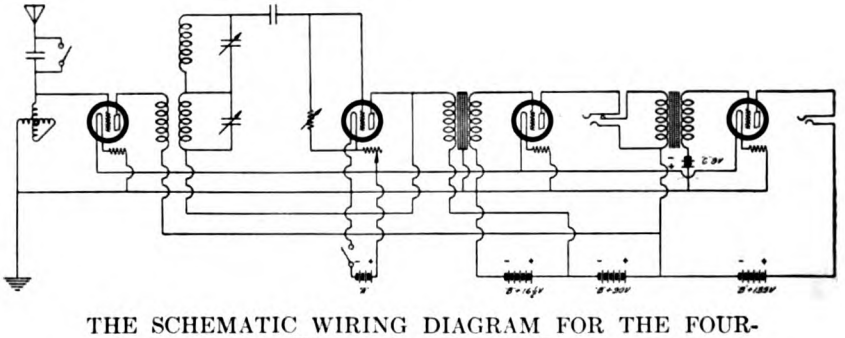
* *

How to Build a Four-Tube LC-26 Receiver

QUESTION: I want to build an LC-26 receiver, but I prefer to use only four tubes instead of five. To accomplish this I am planning to use only two stages of audio-frequency amplication, with two Amertran transformers instead of one stage of transformer and two stages of resistance coupling. Is this plan practical, and can you give me the necessary hook-up?

—HOLMES STANLEY

ANSWER: Yes, this is an entirely practical plan. The added transformer should be the "second stage" type if you wish to



THE SCHEMATIC WIRING DIAGRAM FOR THE FOUR-TUBE LC-26 RECEIVER

FIGURE 1: *The last two stages of audio-frequency amplification, which were resistance-coupled in the original receiver, are here replaced with one stage of transformer-coupled audio-frequency amplification. This plan will eliminate one tube without impairing the fine tone quality which is obtainable with the LC-26 receiver.*

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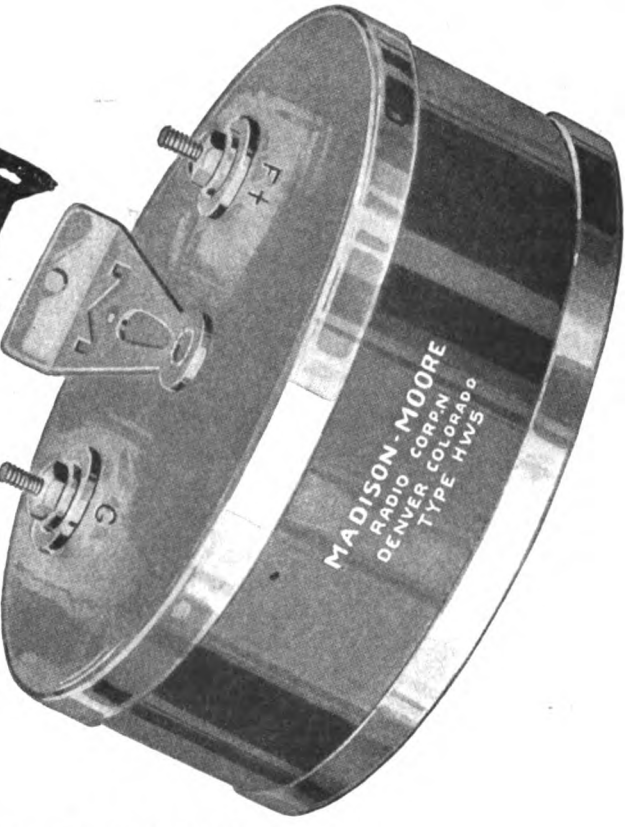
RECEPTION AT ONE POINT only ON THE DIAL



At
ONE POINT
only

Think of It!

There is no reappearance of stations with the *New*

MADISON-MOORE
ONE • SPOT
TRANSFORMER

With this new, improved instrument you log the desired station at ONE particular point on the dial and always bring in that same station at that identical point---not in a half dozen or more places. The intermediate frequency of the MADISON-MOORE ***One • Spot*** Transformer is of such high value that reappearance of any station in the entire broadcast range is eliminated.

In addition to this fixed ***One • Spot*** reception, you get Positive Selectivity, Higher Quality and Greater Distance. Yet, the price of this latest model is less than for the former one!

To know the joy of exact selectivity without duplication, and to get a world of Radio Satisfaction, install MADISON-MOORE ***One • Spot*** TRANSFORMERS.

If your dealer can't supply you, write us.

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MADISON-MOORE

The Finest RADIO APPARATUS *in the World!*

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Bring the Musical Quality of your Radio up to 1927

THE chief difference between your present set and one of the latest design is—*tone quality*. This you can quickly remedy without rewiring or changing the circuit. Merely replace the old audio transformers with Jefferson *Concertones* and enjoy the most lifelike, modern-day reproduction of programs!

These large new Jefferson *Concertones* evenly and faithfully amplify all voices and all instruments. Their musical range is *complete*. They do not lose, distort or "blast" any audible notes from the lowest (30 cycles) to the highest (10,000 cycles). Ideal for safe, continuous use with high-voltage power tubes. Unaffected by humid climates. Fully shielded in handsome green enameled metal cases.

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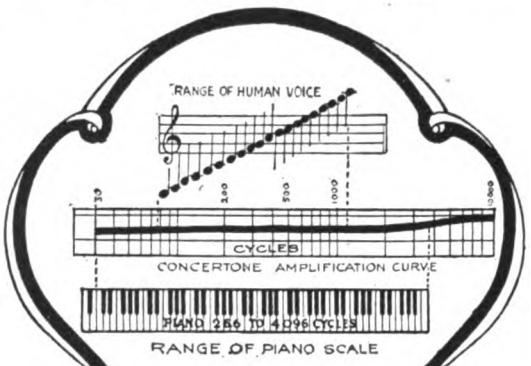
Largest manufacturers of small transformers
508 So. Green St., Chicago, Ill.



Sealed!
Dampness or moisture cannot reach the core or windings, to cause corrosion and open circuits. Each Concertone is sealed and waterproofed in its metal case

Jefferson
Concertone Transformers

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New 1927 Radio Guide Free

The new Barawik Guide, the big 164-page book that hundreds of thousands of radio enthusiasts turn to when they want the latest and best in radio. It's the handiest and most reliable radio reference guide, and a big money-saver besides. Keep up to date by utilizing Barawik service. It will help you to solve many a radio problem and save you tremendous sums on the very things you need and use most.

Brimful of the best approved standard radio sets, parts, and kits, at savings that will appeal to the thrifty. Profusely illustrated with reliable, guaranteed goods at a real saving.

164 Pages of Bargains

It gives 164 pages replete with reliable information about the newest and most advanced ideas in radio development, describes and illustrates the latest improvements. It will keep you posted on what's up to date. It will help you to build a better set or buy a complete new modern one. Every radio set owner, amateur, beginner and fan should have a copy.

Get Our Prices on Parts

It will pay you to get our prices for complete parts for the popular circuits featured in POPULAR RADIO and other magazines. Whenever a new circuit appears for which you want complete parts, write or wire us and they'll be on their way to you quickly. We know what parts to send you. Simply give name of circuit and we'll take care of the rest. We guarantee you a big saving on every order.

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Get our new radio catalog today before you spend another cent on radio. Just mail the coupon and free copy will be sent you. Also please include name of a friend interested in radio to whom we can send free copy.

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Test your battery without withdrawing the Hydrometer. Balls make reading simple and easy.

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Accurate—durable—no float to read or break. Over six million patented Chaslyn Balls used by leading Battery Manufacturers as standard equipment in Glass-Cased Batteries and Power Units.

Ask your dealer. If he can't supply send seventy-five cents to:

THE CHASLYN COMPANY
4609 Ravenswood Avenue Chicago

obtain the same fine tone quality as the original LC-26 receiver. The diagram for the connections is shown in Figure 1. You will notice that all connections up to and including the input to the third tube remain the same as in the original diagram. The output of the third tube goes to the new audio-frequency transformer, and also to a headphone jack. The plate voltage on the third tube is reduced to 90 volts.

The plate voltage on the last tube will depend upon the type of tube used. A power tube is strongly recommended and this may be of either the UX-112 or the UX-171 type. If the plate voltage is supplied from dry-cell "B" batteries, the use of the 112 tube with a plate voltage 135, as shown in the diagram, is recommended. The "C" battery voltage required on the last tube will then be approximately 9 volts.

* *

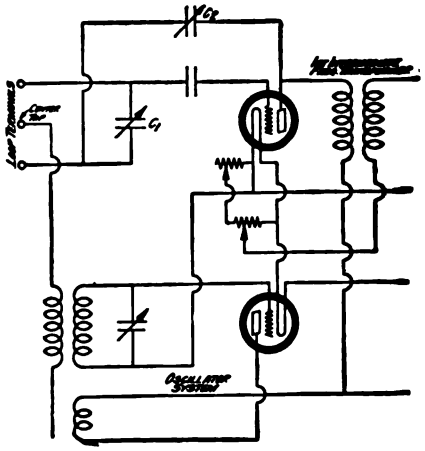
How to Eliminate Excessive Whistling in the Superheterodyne

QUESTION: I am using a superheterodyne receiver and although tone quality and DX reception are wonderful, I find some difficulty in tuning in distant stations because of numerous whistles which are constantly present at many points on the dial. These are not regenerative whistles caused by my own receiver because I get them when the intermediate amplifier is not oscillating. During the daytime I have much less trouble from this source, and after midnight the number of whistles gradually diminishes. The receiver is a straight seven-tube super and employs a loop antenna. Can you suggest the cause and remedy for my trouble?

—DANIEL CUMMINS

ANSWER: Your trouble lies in the fact that your loop circuit tunes too broadly. As a result several signals are present in your first tube circuit at the same time as the signal that you are trying to tune in. These frequencies or beats between some of these frequencies, and the fundamental or harmonic frequencies of your oscillator, combine to give you heterodyne beats of audible frequency.

The first step toward the elimination of



ADDING REGENERATION TO THE SUPERHETERODYNE

FIGURE 2: *To sharpen the tuning and increase the sensitivity of a standard superheterodyne receiver it is necessary to take a third lead off the loop and add the variable condenser shown at C2. The above drawing gives all the wiring changes.*

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this fault is to check over the circuit of your first tube to make sure that there are no poor connections that might provide high resistance and therefore broad tuning. If you cannot eliminate your trouble in this way, we suggest that you alter this circuit as shown in Figure 2. To make this change you will notice that a third connection is required on the loop; this is made by scraping the insulation off the winding of the loop, at a point approximately at the middle of the winding, and connecting the third lead to this point.

The small variable condenser, marked C2 in the diagram, is a midget condenser with a maximum capacity somewhere around 50 micro-microfarads (.00005 mfd.). The purpose of this little condenser is to permit the control of oscillation in the circuit of the first tube. The other instruments shown in the diagram represent the ordinary parts used in a standard super-heterodyne input circuit, and are presumably those that you now have in your receiver.

After your circuit has been changed in accordance with the diagram, tune in any convenient station in the usual manner. It is best to set condenser C2 with its plates unmeshed at first. After the station has been tuned in, turn the knob of C2 until just before the point where the tube breaks into oscillation. This control is then left at that position, and it will require practically no further attention.

This scheme will not only make your input circuit more selective, and thus stop the trouble you have had with heterodyne whistles, but it will also increase the sensitivity of your receiver.

* *

How to Use the 200-a Detector Tube in the LC-26 Receiver

QUESTION: I have substituted a UX-200-a type detector tube for the old 200 type used in my LC-26 receiver, after adding a 20-ohm rheostat, as specified on page 470 of the September, 1926 issue of POPULAR RADIO. The result of this change has been to almost treble the volume of incoming signals, and to greatly increase the sensitiveness of the receiver. On the other hand I find difficulty in controlling oscillation unless the rheostats are adjusted for maximum resistance; and in that case a peculiar fluttering sound starts which ruins reception. I might add that I am using a Raytheon power-pack for the plate supply.

—ANDREW LLOYD

ANSWER: The trouble you mention will sometimes occur when a UX-200-a type detector tube is used in an LC-26 receiver which draws its plate voltage from a Raytheon power-pack, but only when the filament of the UX-200-a type tube is lighted at lower than normal brilliancy.

The solution of the problem is to decrease the plate voltage on the plate of the UX-200-a type tube, and to operate the filament at approximately normal voltage, that is, five volts. The proper plate voltage in this case will be found to be somewhere around 15 volts, and is obtained by turning the knob of the detector plate voltage control as far out as it will go and still make contact inside of the Bradleyohm which is used for this purpose. This point is best found by turning the knob all the way out, and then slowly turning it in again until there is just a perceptible increase in the strength of the signal which is tuned in. If turned in too far the signal will become loud and rough.

ATTACHES easily to your present set, rests in a console beneath it, banishes B-batteries—once adjusted requires no more attention—omits *nothing* for fidelity of audio amplification at natural volume.

The modern broadcast station puts its beautiful programs on the air through a faultlessly designed amplifier. The NATIONAL Power Amplifier attached to your present Radio set, passes on the program to you unchanged, lifelike and real. Don't blame the broadcast station for poor reception until the NATIONAL Power Amplifier has squarely placed the blame on it. For with this fine new instrument the quality is limited only to that of the station you are listening to.

Price, completely assembled and tested (without tubes)—$89.00.

Raytheon BH Tube extra—$6.00

Sold also in kit form wi[illegible] assembly in an evening.

Price of kit (with Rayth[illegible] audio tubes)—$84.00.

NATIONAL products are built to engineering standards of excellence. Anyone who has ever built a set using NATIONAL BROWNING-DRAKE Coils and Transformers knows what that means. Send for Bulletin 116-PR.

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Taste Romance and Adventure In the Far Lands of the Earth

How often **you've longed to see for yourself** the awe of Egypt's pyramids—the beauties of the gorgeous Mediterranean sunset—the squalor of China's ancient cities!

Spend a few years, or the rest of your life, tasting high adventure on the seven seas and in all the world's great ports—roving the earth's highways and byways! You can do it FREE—all your expenses paid—and earn a good salary besides!

Only one profession will carry you around the world at will, travelling like a gentleman, but that's the most interesting and pleasant work there is—Radio Operating! Easily and quickly learned, there's no other profession like it for the man who wants the experiences and pleasures of world-travel. Radio operators are needed—all sea-going ships like the one shown here must carry from one to half a dozen or more.

Take a Look Beyond the Skyline-Without a Penny's Expense

Radio operators aboard ocean liners live luxuriously—they rank as officers of the ship. Meals, a private cabin, all other living needs are furnished free, and besides the operator draws a good salary. You can learn quickly and easily at home in your spare time to be a Radio operator through our practical training methods. Take a look at the FREE BOOK which tells how—mail coupon below.

This U. S. Government-recognized school has been training successful operators since 1914. Our graduates are all over the world. We maintain an Employment Department to put you on your own ship. The world-famous NATROMETER, our own patented invention, obtainable only by students of this Institute, is recognized as the best and easiest way to learn the Radio code. A few short months with the aid of the famous Natrometer and our quick home training, and you too can be a fully qualified Radio operator, sitting in [illegible] cabin like the one shown above, bound out [illegible] verpool or Nagasaki!

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Three Prize-Winning Ideas for Improving Programs

(*Continued from page 136*)

Charles D. Isaacson

Winner of the Second Prize

Harold Moore

Winner of the Third Prize

From 8:00 to 9:00 the singers will be allowed to sing.

For the next hour, 9:00 to 10:00, those who tune in on Station Number One will hear the jokesters of radio; whatever "Boys" or "Twins" or Toms or Dicks or Harrys which the resources of the station can command.

From 10:00 to 11:00 comes the hour that I would assign to the musical or choral group sent by advertisers or by their own urges to be heard.

Finally, as the evening wanes, we have the inevitable and repose-inviting jazz.

Station Number One, then, merely retains its present, well-standardized program. What do we specify for the other six stations? As will be clear from the diagram, these have exactly the same sequence of types of program material, but displaced one hour.

Station Number Two repeats the program of Station Number One, *one hour later*. Station Number Three is still another hour behind, and so on.

I do not mean, of course, that these succeeding stations repeat the same actual programs! The sameness is merely in the type of material presented. All of the stations will present, for example, one hour each evening of talks. Each station will have a different set of talkers. And the talk hour will come from each station at a different hour of the evening.

The advantages of this scheme will be apparent if you run your eye along one of the horizontal lines of the program diagram.

Take, for example, the seven-to-eight o'clock section, when supper is over and a little radio is called for. Station Number One, it is true, is presenting the talk which now is virtually inevitable at this hour from all stations. But there are five other stations. One station has an orchestra, one has some singers, a third has ensemble music of some sort and a fourth is in the hands of humorists. There is even one that has jazz.

Whatever your taste, while you are waiting for your supper to digest, you can find something from one station or another, to suit what you wish.

The same will be true during the next hour and the next. There is always variety; always something to please each of the larger groups of moods or tastes to which we human animals are subject. There is even provision for the individual who wants to hear the same kind of thing all evening. The jazz party merely has to tune in a different station on each

Hour	*Station One*	*Station Two*	*Station Three*	*Station Four*	*Station Five*	*Station Six*
6 to 7	Orchestra	Jazz	Ensemble music	Humor	Songs	Talks
7 to 8	Talks	Orchestra	Jazz	Ensemble music	Humor	Songs
8 to 9	Songs	Talks	Orchestra	Jazz	Ensemble music	Humor
9 to 10	Humor	Songs	Talks	Orchestra	Jazz	Ensemble Music
10 to 11	Ensemble music	Humor	Songs	Talks	Orchestra	Jazz
11 to 12	Jazz	Ensemble music	Humor	Songs	Talks	Orchestra

THE "PROGRAM DIAGRAM"

This chart shows how the broadcast programs of a group of stations (in this case, six of them) might be so co-ordinated that the listener could select the type of program feature that he prefers at any one time.

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hourly change. Persons who desire to listen for a whole evening to the professors—if any such individual still survives—can do likewise and have their aches for learning eased.

The essence of the plan is, of course, the idea of staggering the periods devoted to one or another class of program, so that the different stations in one city or region would always have different types of material on the air. Every listener whose tastes are at all catholic would find something to suit.

It does not matter whether there are six stations in such a plan or sixteen; it does not matter whether the allotments of hours and types of programs are the same for each evening or whether they rotate; it does not matter how long the periods are; whether one hour or a half hour or even shorter.

What *does* matter is the idea.

It would protect us from the eternal sameness of turning dials one point after another to bring in nothing but repetitions of jazz and then jazz and then more jazz.

"Each Station Should Identify Itself by a Specialized Program"

By CHARLES D. ISAACSON
Program Director Station WRNY

(Winner of the second prize of $20.00)

JUST as persons, playhouses and publications have learned that it is better to stand for something definite, rather than to try to encompass everything, so it would seem radio broadcast stations might follow suit.

Magazines, even of national character, adopt a character and classification. Even newspapers are not just newspapers. Persons are specialists. Playhouses are known by type.

Radio broadcast stations, eager to please everybody and lose no one, madly endeavor to cover everything.

The station which stands for a more specialized program will do much for itself, the listeners, and a general clearing up of the situation.

This applies not only to music but to dramatics, and educational material. It is better for listeners to know when they want something—dancing, concert music, playlets, inspiration—and that there is one sure place to find it and eventually to expect to be able to tune in to the opera station, the jazz palace station, the vaudeville station, and so on.

If the vaudeville houses can run 365 days a year, and "Abie's Irish Rose" for five years, why not radio stations with constantly altering variations of a definite policy?

Temporarily, it helps to know the set time any given impressario is serving fish, flesh or fowl—the chowder, chocolate pudding and corn-beef-and-cabbage days. The most successful features are appearing now at stated moments. Therefore, if the time has not yet arrived for stations to be replicas of the "Ladies' Home Journal," "Musical Courier," Metropolitan Opera House, Keith's vaudeville houses, and so on, at least let there be some kind of unity to any given evening.

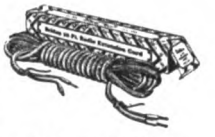
Jumping from hot jazz to hymns is dropping the curtain on one audience and preparing for the next. Why not set the stage for an evening and allow one atmosphere to remain, with all the multiple variations which are possible?

Further, why not weave a thread, somewhat connecting the different features? The announcer, backed by the ingenious program director can keep a "plot" going, however thin or vague.

Inside Aerial and Loop Wire

Beldenamel Aerial Wire

Lead In and Ground Wire


Belden 20-Ft. Radio Extension Cord

Belden Accessories that *Improve Your Set*

FOR an outdoor aerial, use a Beldenamel Aerial. It cannot corrode or deteriorate. For indoor aerials, use the Belden Indoor Aerial Wire. And do not forget Belden Lead-In and Ground Wire to finish the job. All of these items are included, if you wish, in the new Belden Superadio Antenna Kit.

The Belden 20-foot Loudspeaker Extension Cord brings the loudspeaker where you want it. For safety to tubes and batteries, and protection against fire, use a Belden Fused Radio Battery Cord.

Ask your nearest dealer to explain how Belden Radio Accessories help you get better results from your set.

The Belden Fused Battery Cord provides:

1—An A-battery fuse.
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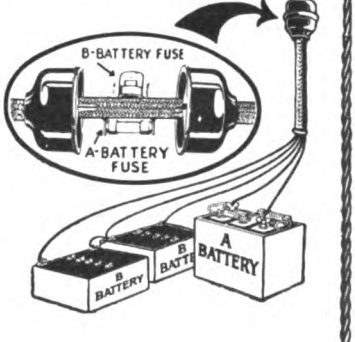
3—A polished bakelite cover for the battery fuses.
4—A compact connecting cable that dispenses with loose wires.
5—A color-code on each wire for identifying each circuit.
6—A time saver, because the cord is quickly connected and easily concealed.



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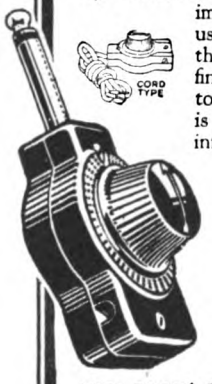
THOUSANDS OF RADIO SET OWNERS *need these improvements*

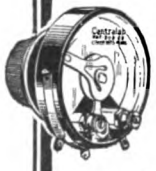
THE U. S. Navy, the Signal Corps and 69 makers of leading standard sets use the variable resistance controls made by Central Radio Laboratories. These improved controls should be used on your set if you want the last word in quality for fine reception. Yet, owing to our huge output the cost is no more than for many inferior devices.



Modernize Your Old Set with

Centralab Modu-pluG

Tone volume is, as you know, the one big improvement in this year's best sets. You can enjoy this improvement with your present receiver for only $2.50. Modu-Plug is especially for that purpose. It provides full tone volume control from a whisper to maximum, simply by adjusting the small knob on the plug. Matches the speaker impedance to the set. Attaches instantly without tools.



Standard type Modu-Plug replaces present speaker plug. Cord type fits sets not equipped with jacks. Either type, at dealer's, or mailed direct **$2.50**

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With "A" Battery Switch

Here is the variable resistance, guaranteed always smooth, noiseless and permanent in adjustment. Tapered to control oscillation and volume, it also has a positive, quick acting "A" battery switch. One knob replaces two. Turning knob to right lights tubes, then increases volume. To left decreases volume, then cuts off batteries. Resistance is 0 to 500,000 ohms. You cannot imagine the great improvement until you try it. Adapted to all circuits.

At dealer's, or mail direct..... **$2.50**

Centralab RheostatS

Where your old design rheostat overloads, heats-up and quickly becomes noisy on new style tubes using increased current. Centralab Ribbon-type Rheostats will operate smoothly and permanently quiet. Insulated metal discs hold rigid a smooth flat resistance surface instead of wires, insuring even regulation and no dead spots. Every set using this rheostat is improved. 2 resistances for 5 to 10 tubes, at dealer's, or mail direct, **$1.25**

We make variable resistances for both the U.S.Navy and Signal Corps and for 69 makers of leading standard sets

SEND NO MONEY—If your dealer isn't supplied, order direct from us. Send no money. Simply pay postman on delivery, plus few cents postage. Install and test for 10 days. Then if you are not more than pleased and delighted with the wonderful results, return the goods to us and your money will be *refunded.* **10 DAYS' FREE TRIAL!**

CENTRAL RADIO LABORATORIES
17 Keefe Avenue Milwaukee, Wis.

Centralab

Which brings us down to individual features. It is never necessary for even the last lonely soprano to give a disjointed fifteen minutes. It is pure laziness on her part and the station officials when her act has no rhyme or reason. Let her assume some character, let her few moments take on a color, atmosphere, idea. It's remarkable how a little intelligent juggling makes what is otherwise utterly stupid into an interesting and stimulating diversion. But it will take time and money.

A broadcast station with a small stock company of clever people in their specialty of varied specialties, rehearsed in a constant series of timely, interesting divertissements, would be the sensation on the air. But it would take some money, lots of ingenuity and brains.

"Prevent by Law the Interference of Broadcast Stations"

BY HAROLD MOORE

(Winner of the third prize of $10.00)

BEFORE offering any suggestions looking to the improvement in radio broadcasting it will be necessary to discover who is getting the most out of radio and what are the benefits derived. This will further necessitate the analysis of radio programs as to their use and the class of listeners patronizing them.

Radio programs naturally fall into three grand groups:

1. The program of entertainment
2. The program of education
3. The program of business

Programs of entertainment no doubt command the largest number of listeners.

Programs of education have a small but earnest group of listeners.

Programs of business probably have the smallest total of listeners; but within this group we find one class of patrons who are deriving great practical benefits from radio. I have reference to the rural class, or specifically the farmer. Radio has been a great invention for the farmer. It has become an indispensable factor in his social and economic life; in fact, it has become a part of his everyday life, and he is depending more and more on the radio to govern his day's activities.

As this nation is an agricultural nation, depending to a great extent upon the rural element for its prosperity, and standing among the great countries of the world we can readily see that any factor promoting the interests of the farmer effects the nation as a whole, and each and every individual therein.

Therefore, what improvements can be be made in radio broadcasting that will maintain this practical and beneficial feature to the third group and at the same time please the hordes of listeners in the first and second groups?

The most important improvement in radio broadcasting would be for Congress to pass a law classifying the stations and regulating the distribution of wavelengths. The public recognizes and appreciates the wonderful service given by the big stations, and these Goliaths of the air should be given permanent wavelengths, and preference in other regulations. I know of no one thing that is more annoying and detrimental to the service than to have some lesser station move up into the territory of the more important stations. A single powerful local may blot out many stations for some listeners and a few for the perfectly equipped expert. We of the midwest have to contend with a dozen powerful stations and scores of less potent but equally persistent broadcasters. Taken as a whole, the broadcasting situation is

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☐	Set No. 18	☐	Set No. 25

(See page 200 for description of Sets)

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satisfactory—but exasperating. The air lanes are overburdened and traffic regulations inefficient. A corps of air cops will have to be formed, men who will everlastingly listen in and have the authority to pull in to the curb broadcasters who are "broad" pirates who sail the air without license, and other disturbers too numerous to mention.

I believe this would be a great improvement in broadcasting and would favorably impress all groups of listeners. And the thought in this paper is a "law" governing and regulating the broadcasting stations in order that practical benefits that are now being realized may be maintained and assured, with the resultant benefit to all. This law could be hurried along by the concerted action of the broadcasting stations and the popular appeal of the radio fans to their congressman. I would like to see a radio magazine sponsor this kind of movement.

It Is Reported That—

THE radio industry now ranks 33rd on the list of large industries in the United States, taking its place with the shipbuilding, leather and chemical industries.

* *

THE sales of radio apparatus in the United States are now twice as large as the sales of kodak and sporting goods; twice as large as carpet and rug sales, and one third as large as all furniture sales.

* *

IN 1925 the sales of radio batteries, both dry and storage, in this country amounted to $45,000,000—a sum equal to the sales of batteries for all other purposes except automobiles.

* *

IN the same year $50,000,000 was spent for vacuum tubes for radio sets and an almost equal amount for loudspeakers and similar accessories.

* *

THE number of radio manufacturers in the United States is estimated at not less than 3,000, and perhaps as high as 5,000.

* *

IT is estimated that nearly half a million people are employed directly or indirectly in the radio industry in the United States.

* *

THERE are approximately 25,000 radio dealers in the United States and nearly 1,000 jobbers; 5,000 of these dealers handle radio apparatus exclusively.

* *

IT is estimated that there are at least 350,000 radio sets in present use by farmers alone.

* *

ABOUT fifteen colleges and universities in the United States are now giving lectures and extension courses by radio; four or five of them enroll their radio students and issue certificates upon completion of the courses.

* *

THE average price of the present day radio set is estimated at $80; this estimate is based on a listing of all the sets now on the market.

* *

THE weight of the average receiving set is 13 pounds.

* *

THE average sale per radio customer (based upon information recently obtained from a group of five representative retail stores), amounted to $95. This compares with $51.88 in 1924 and $16.22 in 1923.

First in the Field Specializing in Cockaday Kits

S. HAMMER RADIO CO., 303 Atkins Ave. Brooklyn, New York

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All you need do is to connect bus-bar according to diagram, solder and your set is finished. These Kits are sent to you completely mounted, and assembled on a Veneered Mahogany baseboard and genuine bakelite panel, drilled and engraved. Genuine parts used as listed below; exactly as used in Mr. Cockaday's Laboratory Model. COMPARE OUR OFFER!

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SENIOR AND INTERMEDIATE POWER PACKS

1 Hammarlund mid-line dual condenser, .000275 mfd	$ 7.50
1 Hammarlund mid-line single condenser, .000275 mfd	4.65
1 Precision Duo-Octoform coil set comprising one antenna coupler and two interstage couplers	10.50
1 Amertran De Luxe first stage transformer	10.00
1 Amertran De Luxe second-stage transformer	10.00
1 Amerchoke # 854	6.00
1 Dubilier or Tobe 4 mfd. Filter condenser	5.50
1 Dubilier filter condenser, .1 mfd	.60
1 Mar-Co illuminated control, scale 0 to 100	3.50
2 Mar-Co small controls scale 0 to 50 and 50 to 0	1.50
1 Carter Battery Switch	.65
1 Samson radio-frequency choke coil # 85	$1.50
3 Aerovox, mica fixed condensers, .00025 mfd	1.05
1 Durham or Daven Resistor 4 meg	.50
1 Lynch Grid Leak Mounting	.35
1 Carter Gem Jack	.25
1 Carter variable resistance, 0-10,000 ohms	2.00
12 Eby binding posts	1.80
5 Benjamin UX Sockets	3.75
1 Amperite No. 1	1.10
Mechanical Kit consisting of aluminum shields, binding post strip, decorated panel and Tait brackets	12.50

READY-TO-WIRE KIT PRICE $85.20

LC-27 SENIOR POWER PACK KIT $65.20

LC-27 INTERMEDIATE POWER PACK KIT $47.50

SILVER SHIELDED SIX KITS *In Stock Now!*

HAMMARLUND-ROBERTS HI-Q KITS

Authorized Headquarters for the NEW! KENNETH HARKNESS KH-27 Receiver

The Above Kits Can Also be Obtained Completely Wired to Specifications

Write for our interesting special circular which we have prepared on the LC-27 Receiver and above Kits.

Authorized service station for the LC-27.

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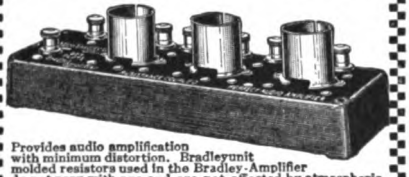
Resistance-Coupled

PERFECT AUDIO AMPLIFIER



Provides audio amplification with minimum distortion. Bradleyunit molded resistors used in the Bradley-Amplifier do not vary with age and are not affected by atmospheric conditions. Can be used to replace transformer amplifiers in standard radio sets with decided increase in tone quality.

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THE PERFECT GRID LEAK

Provides a noiseless range of grid leak resistance from ¼ to 10 megohms. Assures most effective grid leak resistance value for *all* tubes. Small grid condenser (0.00025) is separate. Metal parts nickel plated. One hole mounting.

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276 Greenfield Avenue Milwaukee, Wis.

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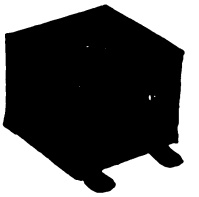

No. 3527 Unit

Increase the Volume of Your Present Set

It is easy now to get much greater undistorted power from your present radio receiver whether it has 2 tubes or 8 tubes. At the same time and at little additional expense you eliminate the need of B-batteries.

No. 3527 Unit
Full Wave Rectifier
for use with

one UX 213 tube and power amplifier UX No. 171 tube. This unit includes one No. 2505 transformer and two No. 514 chokes.
Full Power and B-battery Eliminator.
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Full Wave Rectifier
for use with

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Fans—Send check or money order to factory if your dealer cannot supply you. Deliveries are prompt.
Manufacturers—As exclusive parts manufacturers Dongan offers the receiver and battery eliminator manufacturer a reliable source of supply. Our engineering department will co-operate with you in effecting the proper designs of the latest types for your requirements. Ask for a representative or send your specifications.

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What Really Comes Through Your Transformer?

We know what you want to get out of your set. Everyone wants it. It is clear, pure-toned reception—and you don't want to miss a note from the muffled base of the kettledrum or the profound booming of the bass-viol to the shrill "sky-high" tones of the fife and piccolo.

So much depends on your circuit, so much on your speaker—but even more on your transformers. To render sweet music and to get the full range of orchestral or instrumental performance, the transformer must faithfully reproduce all frequencies.

The FERRANTI transformer meets every condition of good audio reception

By installing Ferrantis you can modernize your old set or perfect your new one. With its amplification curve an almost straight line, Ferranti will give you an uncensored message from the sending station.

Ask your dealer for Ferranti Transformers. If he does not carry them, write us and we shall tell you where you can get them. No better transformer is available at any price.

HIGHSPOTS

High amplification ratio with flat curve.

Ferranti brings out the fundamental frequency of low tones—none are heard merely by inference from higher harmonics.

Every transformer tested ten times—all short-circuit turns eliminated.

Windings have high impedance.

Built by an established manufacturing company with forty years' experience in the winding of coils of fine wire for electrical instruments and meters.

Primary shunted with built-in condenser of correct capacity.

Tested to 1000 volts between primary and secondary and between primary and secondary and ground.

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130 West 42nd Street
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WITH THE EXPERIMENTERS

CONDUCTED BY RICHARD LORD

How Power Tubes Improve Reception

POWER tubes are power handlers, not power producers as many think.

Of itself, a power tube will not produce more volume than a non-power tube. The value of a power tube lies in the fact that its design permits it to handle greater volume without distortion.

Most receiving sets are capable of delivering more volume to the last audio tube than can be handled without distortion by the usual types of amplifying tubes. This is where the power tube is needed—in the last audio stage—where it can receive the volume developed in the earlier stages of the set and pass it on, amplified but undistorted, to the loudspeaker.

The electrical characteristics of power tubes are quite different from those of the customary amplifying tubes. Power tubes consume more "B" battery current and they require greater "C" battery voltage.

The wrong "C" voltage robs the power tube of its ability to handle greater volume without distortion. In addition, if the "C" voltage is too low, the "B" current consumed by the tube is multiplied many fold, which rapidly exhausts the "B" battery. Merely substituting a power tube for some other tube in the last audio stage of a receiver will not bring about any noticeable improvement in reception. Provision must be made to allow placing the correct "C" voltage on the grid of the power tube.

The newest power tubes are the CX-371 and UX-171. These tubes can be operated on "B" battery voltages of 90, 135 or 180 volts. For ordinary home use, 135 volts of "B" battery will supply ample for the CX-371 and UX-171 power tubes.

With these tubes, when the "B" battery voltage is 135 volts, the "C" battery voltage should be 27 volts. A new 22½-volt "C" battery has been introduced by one of the battery manufacturers, and, when connected in series with a 4½-volt "C" battery, the combination will deliver the 27 volts required by these power tubes operating at 135 volts of "B" battery.

—N. W. AYER

Two Useful Tables for the Coil Winder

HERE are two tables that the amateur will find many uses for.

TABLE I

Turns Per Inch of Magnet Wire on Coils

size B & S gauge	*enameled*	*single-cotton-covered*	*double-cotton-covered*	*single-silk-covered*	*double-silk-covered*
20	29	25	23	27	26
21	32	28	26	31	29
22	36	31	28	34	32
23	41	34	31	38	36
24	43	37	33	42	39
25	51	41	36	47	43
26	56	43	39	52	46
27	64	49	42	57	52
28	71	54	45	63	56
29	79	58	48	70	63
30	88	64	56	77	67
31	100	69	57	85	72
32	112	75	60	93	78
33	134	81	64	102	84
34	140	87	66	112	91
35	156	94	73	120	97
36	173	101	78	130	104
37	201	108	84	141	110
38	225	115	89	151	117
39	256	122	95	163	123
40	288	130	102	179	129

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The first table may be used to determine how much wire will be necessary to wind coils of various sizes and kinds of magnet wire and to aid in calculations of inductance and resistance.

The second table will give the number of inches of wire around a core of a given diameter and also the circumference of the core's diameter. It may be used in the calculation of resistance and inductance as well.

TABLE II

Number of Inches of Wire Around a Core of a Given Diameter

diameter in decimals	*diameter in fractions*	*circumference*
.25	¼	.785400
.50	½	1.57080
.75	¾	2.356200
1.0	1	3.1416
1.50	1½	4.71240
2.0	2	6.2832
2.5	2½	7.85400
3.0	3	9.4248
3.5	3½	10.99560
4.0	4	12.5664
4.5	4½	14.13720
5.0	5	15.7080
5.5	5½	17.27880
6.0	6	18.8496
6.5	6½	20.42040
7.0	7	21.9912
7.5	7½	23.56200
8.0	8	25.1328
8.5	8½	26.70360
9.0	9	28.2744
9.5	9½	29.84520
10.0	10	31.4160
10.5	10½	32.98680
11.0	11	34.5576
11.5	11½	36.12840
12.0	12	37.6982

—FREDERICK J. RUMFORD

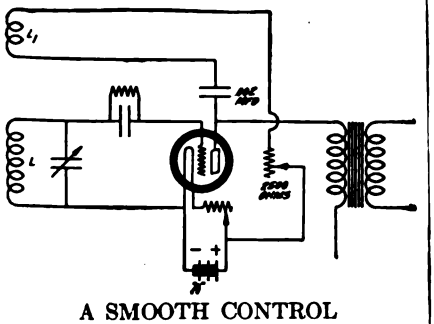
A Smooth Control for Regeneration

IN my article on regeneration, "The Radio Road Hog," which appeared in the October issue of POPULAR RADIO, I did not have space to describe one other efficient and recent type of regeneration control.

The circuit diagram for this method of control is shown in Figure 1.

In this illustration, L is the secondary and L1 is the fixed tickler. The plate connection from the detector tube is direct to the following transformer; this is similar to the arrangement of the wiring for a non-regenerative set.

An additional connection from the



A SMOOTH CONTROL

FIGURE 1: *This diagram shows an additional method, suggested by Mr. Roberts which will give a smooth control of regeneration in the receiver.*

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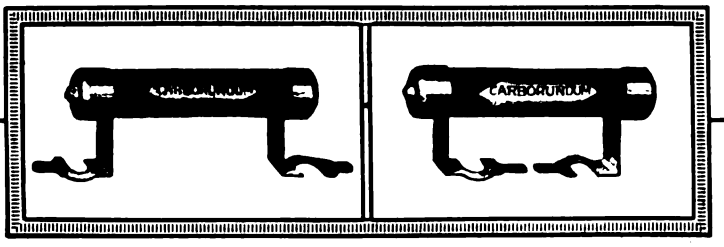

ABSOLUTELY noiseless—

Do not disintegrate with use or time—

No metallic film but instead a solid rod of dense unbreakable Carborundum—one of the greatest of all electrical resisting materials.

Made in all standard values and tested under actual operating conditions.

Grid Leaks or Resistors from your dealer or direct, 35c. each

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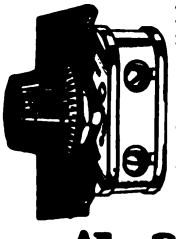
Bradleystat

PERFECT FILAMENT CONTROL



Provides complete noiseless filament control for all radio tubes without change of connections. Metal parts are nickel plated. One hole mounting. Self contained switch opens battery circuit when desired.

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Uses graphite disc resistors which are noiseless and not affected by atmospheric conditions. Metal parts are nickel plated. One hole mounting. Finish and knob match Bradleystat. Made in 200 and 400 ohm ratings.

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—this is the supreme test of radio reproducers, especially the Cone Type.

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No matter what set you may use, the Amplion Cone will help it to give you its best performance.

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One year ago the demand for high grade Fixed Mica Condensers, Filter Condensers, Power Supply Condenser Blocks, and Lavite Resistances forced us to double our floor space and equipment.

Today, even though we are now operating on a 24 hour schedule, we are *again* compelled to double our facilities. With our present plant in full swing—*without costing our customers one single production day*—we are moving to new quarters at 60-72 Washington St., Brooklyn, N. Y.

"Two times two"—this is our growth for the year just passing. Does the "Built Better" policy *pay*? *AEROVOX* thinks so. More than 200 radio manufacturers and thousands of you fans evidently think so, too.

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Double Enjoyment
Volume with Perfect Tone

Why sacrifice the excellent reproducing qualities of a set by the use of an inferior speaker. Proper design and construction has produced in the BURNS Speaker a most satisfying instrument. It is possible to reproduce with amazing exactness every note of music and inflection of the voice that the set is capable of picking up. A trial will convince.

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Ask about BURNS B-Eliminator

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The POPULAR RADIO ATLAS and LOG will give you a list of all the NEW Broadcasting Stations with wavelengths and other necessary information

A Complete Atlas and Station Log

The "POPULAR RADIO International Radio Atlas and Log" will supply you with full information regarding broadcasting stations of the United States and Canada.

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plate of the detector is made through and to the tickler, with a .002 mfd. fixed condenser in series, to keep the "B" (+) plus out of the tickler circuit. The other terminal of the tickler is connected through a variable high resistance to the "A" (+) plus line, between the "A" battery and the rheostat.

While it is not always possible to install this method in a standard set, due to the fact that the condenser and the resistance are in the tickler circuit, thus reducing the efficiency of the tickler to some extent, it may be recommended for a tickler that is hard to control through excessive regeneration on the low waves, and it furnishes a very smooth and positive control of regeneration.

In building a coil for the arrangement, it is generally necessary to add a few turns to the specified number on the tickler windings, in order to balance the added resistance in the circuit of the condenser and the variable resistor.

—J. E. ROBERTS

Modifications of the Browning-Drake Circuit

MANY questions have come to our attention concerning the numerous Browning-Drake receivers which have been described in various magazines.

All these receivers have the same radio-frequency amplifier and simply differ in the layout of the apparatus and in the type of audio-frequency amplifier used. To state that one particular set is better than another is saying that the type of audio amplifier that is employed in any one of the sets is preferred by the designer. Experimenters know that the various types of audio amplifiers—resistance, impedance, transformer, and combinations of the above—all have their good and bad points.

The success or failure of a particular receiver usually lies in the radio-frequency part of the circuit and not as a rule in the audio-frequency end. Therefore, the home constructor should be extremely careful, in building any of the various Browning-Drake sets, to have the wires from the plate of the radio-frequency tube kept well separated from all other wires. This same statement applies to the connections to and from the balancing circuits and to and from the grids of the radio-frequency and detector tubes.

How to Build a One-Tube Receiver for $25.00

In the March issue of POPULAR RADIO, *will appear the first constructional article on the Univalve Receiver—which contains but two tuning dials and a switch on the panel and employs a new type of tube that accomplishes reception equal to that of most ordinary four or five-tube sets.*

Build this set; it will be a marvel to your friends and acquaintances.

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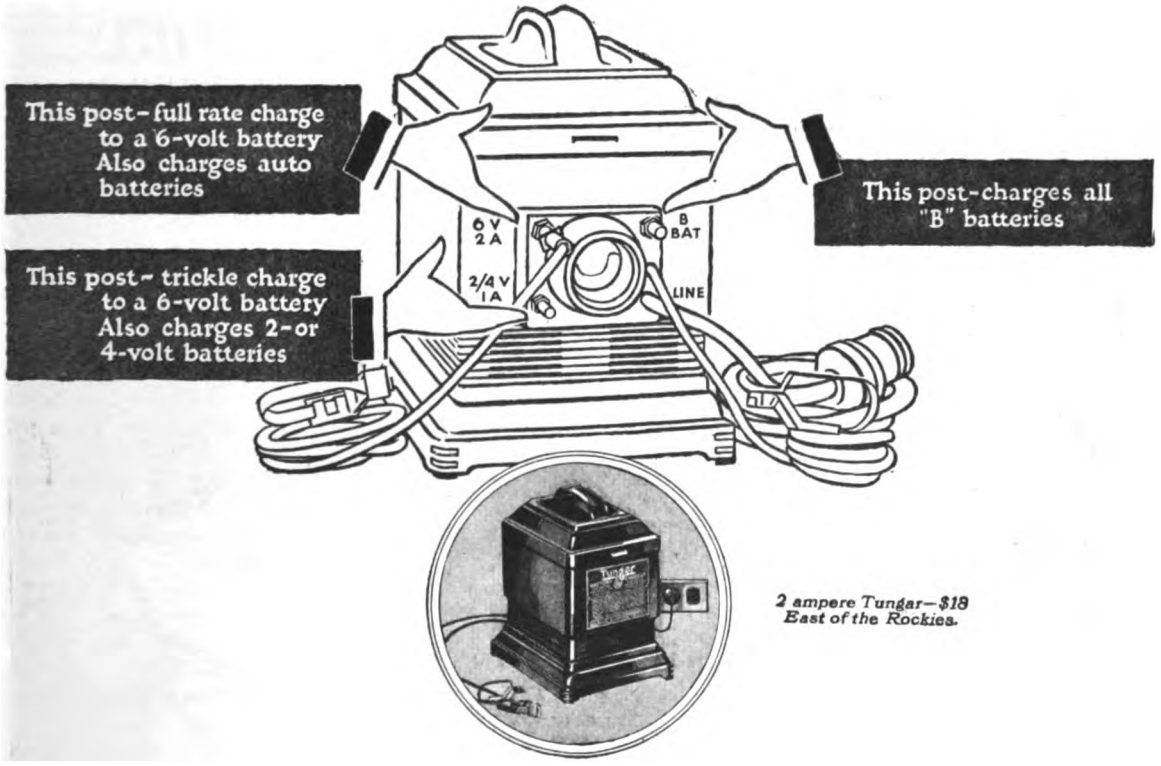
The 2 ampere Tungar will Trickle Charge, too!

Trickle charge a 6 volt battery from one post. Give it a full charge from another. The 2 ampere Tungar charges ALL radio "A" and "B" storage batteries—and auto batteries also. It's a simple matter of connection. Just look at this diagram.


This post-full rate charge to a 6-volt battery Also charges auto batteries
This post-trickle charge to a 6-volt battery Also charges 2-or 4-volt batteries
This post-charges all "B" batteries
6 V 2 A
2/4 V 1 A
B BAT
LINE

2 ampere Tungar—$18 East of the Rockies.

Merchandise Department
General Electric Company
Bridgeport, Connecticut

Tungar
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Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

GENERAL ELECTRIC

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Have you changed it Lately?

FEW people realize what a remarkable improvement they can secure in tone quality by occasionally changing the Resistors in their sets.

Remember that the characteristics of tubes and batteries constantly change. Even when you replace old tubes with new ones there is always a variance.

Changing values within your set require Resistors of proportionately different values if you are to have the harmony and unison of all elements which affects perfect reception.

Most internal Receiver noises are NOT from faulty tubes, "B" batteries or loose connectors, but are purely the result of unstable grid Resistors.

Wise radio owners keep several extra Durham Resistors, of various ranges from 1 to 5 megohms, on hand and occasionally change them to meet varying conditions. Try it yourself and note the immediate improvement in tone quality.

(*500 Ohms to 10 Megohms*)

DURHAM METALLIZED RESISTORS

INTERNATIONAL RESISTANCE COMPANY
Dept. A, 1936 Market St.
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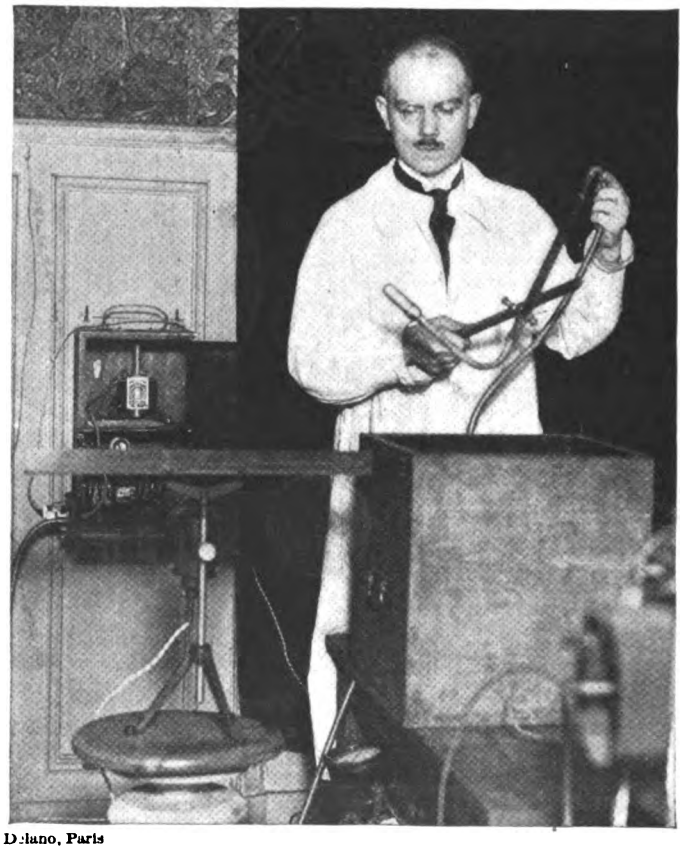
CONDUCTED BY DR. E. E. FREE

Another Proof that All Ether Waves Are Alike

ANOTHER step in proof of the similarity of all kinds of ether waves, from the longest waves of radio to the shortest waves of Dr. Millikan's cosmic rays, has been taken by Dr. A. Dauvillier, of the Laboratory for Physical Research on X-rays, in Paris. It will be remembered that one of the gaps long existing in the series of ether waves was closed some time ago when the late Dr. E. F. Nichols and Dr. J. D. Tear proved that the shortest radio waves could be measured on the same apparatus upon which were detected the longest of the waves of heat. Similarly, these longest heat waves were detected by typical radio apparatus, thus completing the proof that long heat waves and the very short radio waves are identical.*

On the other side of the waves of visible light, being shorter than these visible waves whereas the heat waves are longer than them, there has long been another portion of the ether-wave series which, while not containing an actual gap, has been insufficiently explored. This is the region between the longest of the X-rays and the shortest of the rays of ultraviolet light. Few physicists have doubted, as a matter of theory, that ultraviolet light and X-rays were connected by a region of uniform

*"The Shortest Radio Waves Ever Produced by Man," by Ernest F. Nichols. POPULAR RADIO, Volume 4, Pages 22-29 (July, 1923).



Delano, Paris

HE MEASURES X RAYS LIKE OTHER ETHER WAVES

In addition to examining the X rays with spectrographic apparatus, Dr. A. Dauvillier, of Paris, has also measured their intensity with a photoelectric cell, similar to the cells used for light rays. This supplies another proof that all ether waves, including radio waves, belong to one continuous series.

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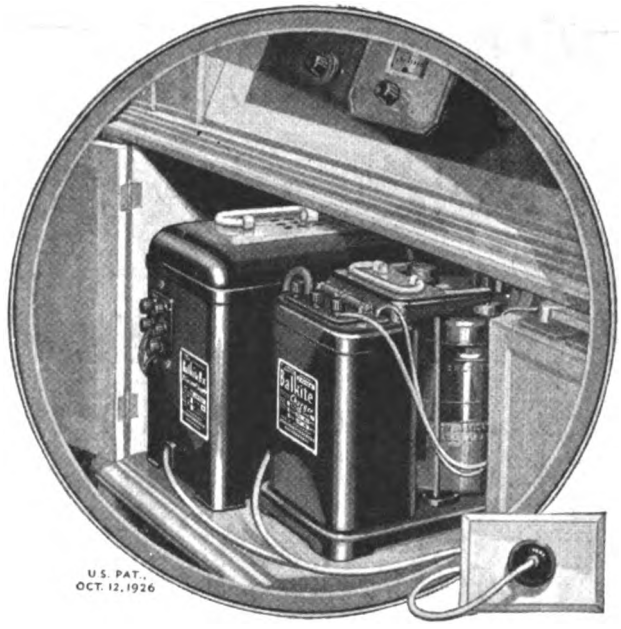

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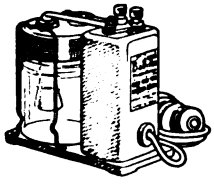

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All Balkite Radio Power Units operate from 110-120 volts AC current with models for both 60 and 50 cycles. The new Balkite Charger is also made in a special model for 25-40 cycles.

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Balkite "B"—the proved "B" power supply—eliminates "B" batteries entirely and supplies "B" current from the light socket. The new Balkite "B"-W serves any set of 5 tubes or less requiring 67 to 90 volts; Balkite "B"-X sets of up to 135 volts and 8 tubes [illustrated]; Balkite "B"-Y any standard set. Most owners of even small sets will buy Balkite "B"-X for its reserve power.

The new Balkite Charger with both high and low charging rates combines the advantages of both trickle and rapid charging. At the low rate, on trickle charge, it automatically keeps your "A" battery fully charged, and in effect converts it into a light socket "A" power supply. Its high rate provides an ample reserve of power for the largest sets.

Both Balkite "B" and the Balkite Charger are entirely noiseless in operation. *Both are permanent pieces of equipment, with no bulbs and nothing to wear out or replace.* Other than a slight consumption of household current, their first cost is the last.

Add these two Balkite Units to your receiver now. Then you too will know the pleasure of owning a radio set always ready to operate at peak power. Ask your dealer. *Fansteel Products Company, Inc., North Chicago, Illinois.*

Balkite Charger $19.50. (*West of Rockies* $20. *In Canada* $27.50.) *Balkite* "B"-W $27.50. "B"-X $42. "B"-Y $69. (*In Canada* "B"-W $39. "B"-X $59.50. "B"-Y $96.)

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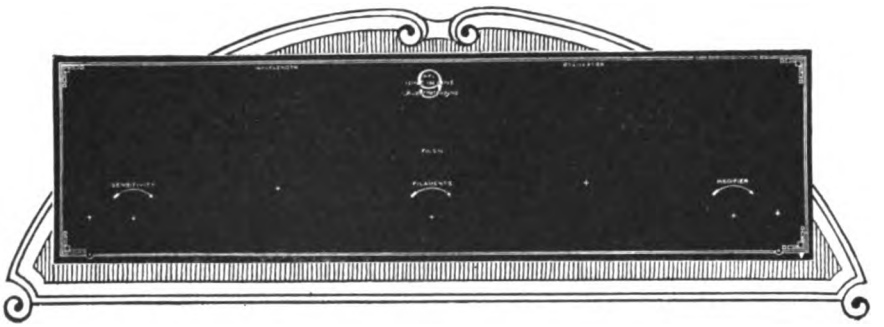

Formica Kit Panels

From one end of the country to the other, home set builders are producing handsome radio sets by the use of Veri Chromed Formica panels for the leading kits.
These panels include the Karas Equamatic, Bremer Tully Power Six, H. F. L. Nin-in-Line, Superheterodyne with sub panel, Victoreen single dial and two dial. There is also an Infradyne 7x28" and 7x30", Aerodyne, St. James 8 Tube, Bremer Tully Counterphase, Browning Drake National, Madison Moore Superheterodyne, Camfield Duoformer, two styles of Best's Superheterodyne. They are sold by the leading jobbers and dealers.

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gradation, the shortest light rays being virtually indistinguishable from the longest X-rays. The contribution of Dr. Dauvillier is that he has succeeded in covering this somewhat doubtful region of ether waves by a continuous exploration, using the standard spectrographic methods which are employed with ordinary light waves.†

It is found, as was expected, that the longest X-rays respond to these spectrographic methods in exactly the same manner as do the shortest ultraviolet rays. Again, we have proof that all of the ether waves are alike. This leaves in the whole series of ether waves only the relatively narrow gap between the gamma rays of radium, which were the shortest waves known until recent years, and the new cosmic rays of Millikan, which are a little shorter. No physicist is much concerned by this gap, as everyone feels sure that the rays which occupy it will be of exactly the same character as the gamma rays and the cosmic rays.

Whatever be the exact physical nature of the thing which we call radiation, including radio waves, light and all the rest, this thing is evidently the same throughout the entire ether-wave series. The cosmic rays of Millikan, the visible rays of light, the new rays in the ultraviolet-X-ray region investigated by Dr. Dauvillier; all are of the same fundamental nature.

†"The discovery of the Characteristic Series O and N of low frequency. A Spectrographic Junction between the X-rays and the Extreme Ultraviolet" (in French). *Comptes Rendus de l'Académie des Sciences* (Paris), volume 183, pages 656-658 (October 18, 1926). Dr. Dauvillier also published an equivalent note in English in *Nature* (London), volume 118, page 551 (October 16, 1926).

A Radio Glow Phenomenon That is Worth Studying

AN interesting line of experimentation which may have, it appears, important possibilities of radio development is mentioned in a brief note signed "B. A. R." in a recent issue of *Amateur Wireless*.* According to this note, if a quartz crystal, similar to those now in common use as control oscillators in radio transmission circuits, be cut into the shape of a rod and placed in a tube containing low-pressure neon gas, this quartz rod will glow when set into oscillation by means of electric energy. The glow results, doubtless, from the electrification of the neon gas in the same manner as in the ordinary neon lamps.

When the frequency of the electric energy supplied to the quartz crystal is the same as the fundamental frequency of oscillation of the crystal itself the whole crystal glows uniformly, B. A. R. reports, with the neon glow. But when the frequency applied to the quartz crystal corresponds with one of the harmonics of that crystal, the neon glow then takes on a banded appearance, the crystal being illuminated in bands which encircle it like painted stripes.

*"Luminous Crystals," by B. A. R. *Amateur Wireless* (London), volume 9, page 735 (November 20, 1926).

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Prevents aerial radiation and feedback.

Insulates against interference from adjoining circuits.

Improves efficiency, selectivity and tone quality.

USE SHEET COPPER because it combines low resistance with easy working qualities.

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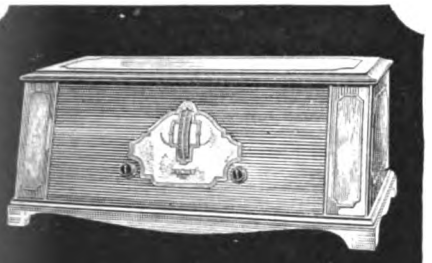

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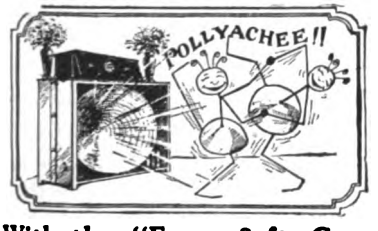

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The New British Radio Beam Service

ON October 25, 1926, the British Post Office Department, jointly with the Marconi Company, began commercial service from England to Canada over the beam-system radio link, stations for which have been under erection for months. A week's test prior to that date had shown the system capable of handling an average of 600 letters per minute, this speed being maintained simultaneously in both directions. On October 26, the day after the announcement of the successful tests of the system, Senator Marconi delivered the James Forrest Lecture of the Institution of Civil Engineers in London, taking for a part of his subject the recent accomplishments and probable future of this new low-power system of long-distance radio. Few recent radio advances have attracted more public attention than the installation thus emphasized and described.

The beam-system consists, as has been described often in POPULAR RADIO, of a transmitting antenna which sends off the major part of the emitted energy in a given direction, instead of scattering that energy broadcast through space. The transmitting antennas have been worked out during several years of tests conducted by the Marconi Company, under the direction of Senator Marconi himself and of Dr. Franklin. Essentially they are great wire screens or curtains, usually constructed of a series of hanging wires. There are two of these curtains, one behind the other. The forward curtain (in the direction in which the radio beam is to be sent) is energized by the transmitting oscillator. The other curtain serves as a "reflector" for the energy, in almost exactly the same way as was demonstrated by Dr. Heinrich Hertz, the discoverer of radio waves, nearly forty years ago.

The wavelength used in the present beam links is approximately one hundred meters. Twenty kilowatts has been found to be sufficient power for the service between England and the Canadian installation, near Montreal. Additional transmitting and receiving stations are being built, faced in the proper directions for beam communication between England and the other dominions of the British Empire. Unfortunately, the beam system cannot yet be applied to the longer wavelengths, the necessary dimensions of the transmitting and reflecting curtains being impracticably large.

The development now needed is some discovery which will permit the sending of directed beams of the relatively long waves from curtains and reflector which are smaller in size than the wavelength of the frequency to be used. No system that promises to accomplish this purpose is visible at the present time.

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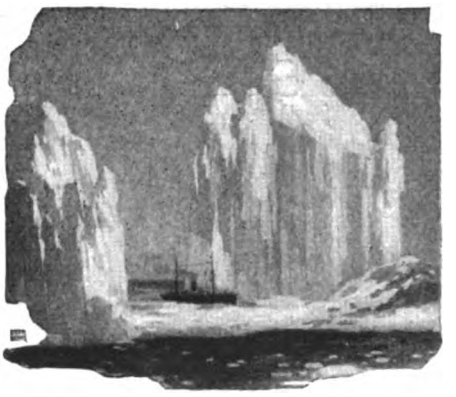

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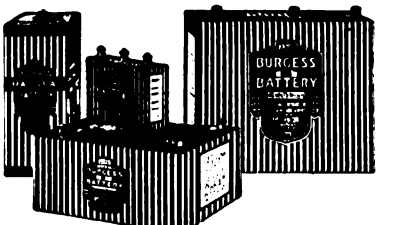

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Electricity in the Upper Air

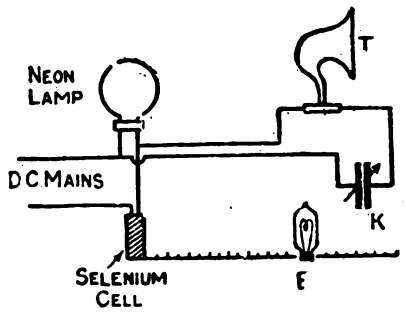
STUDENTS of atmospheric electricity, which now ought to include all students of radio, will be interested in a recent French study made by measurements in balloons and extending to altitudes as great as 20,000 meters (over 12 miles).* On the average, the intensity of the electric forces in the atmosphere was found to decrease up to an elevation of about five miles. Below about two miles the change of the electric field was approximately 10.4 volts per meter. At four miles this had decreased to 2.3 volts per meter. At still higher elevations the electrification again increased, so that fields as great as 40 volts per meter were found at elevations of five to six miles above the ground.

*"Records of the Electrical Field of the Atmosphere Up to 20,000 Meters" (in French), by P. Idrac. *Comptes Rendus de l'Académie des Sciences* (Paris), session of June 28, 1926.

A Novel Neon Oscillator

A NOVEL combination of a neon lamp and a selenium cell, for operation as an audio-frequency oscillator, is described in a recent note by Mr. T. Thorne Baker, the well-known English physicist.* The light of the neon lamp is produced, as is now well known, by the excitation of the atoms of neon gas inside the globe. Under proper conditions of operation a direct-current supply to this lamp produces a glow which seems to the eye to be continuous. In reality, however, this neon glow is intermittent.

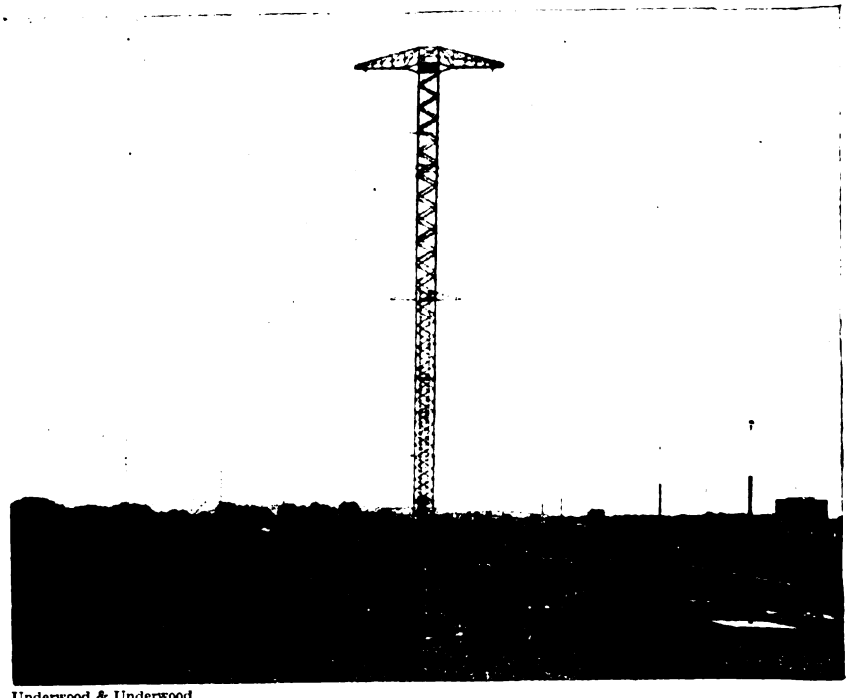
*"A Remarkable Selenium Cell," by T. Thorne Baker. *Amateur Wireless* (London), volume 9, page 634 (November 6, 1926).



From *Amateur Wireless*

This diagram shows an experimental hook-up in which a selenium cell is used to control the frequency of a neon-lamp oscillator.

The pulses of light from the neon lamp correspond, of course, to electric pulses in the circuit with which the lamp is connected. These may be used to produce a low-frequency current, either for direct supply to a loudspeaker or for amplification in the usual way. The frequency of the pulsations of the neon lamp is altered by the resistance in its current-supply circuit. Mr. Baker's device makes use of a selenium cell to provide this alteration in the resistance. The selenium cell being inserted in this current-supply circuit and the rays of an ordinary electric lamp being allowed to fall on the cell, the alteration of the intensity of this light, conveniently arranged for by moving the lamp backward and forward, produces a corresponding change in resistance of the selenium and thence in the frequency at which the lamp oscillates.



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WIRE CURTAINS THAT DIRECT THE RADIO BEAM

This row of tall steel masts, erected at Bodmin, England, support the curtains of hanging wires which send the radio beams to Canada. The lower ends of the vertical wires may be seen at either side of the picture. Attached to them are the weighted levers which hold the wires vertical and at proper tension. The upper ends of the wires hang from horizontal cables attached to the arms of the masts.

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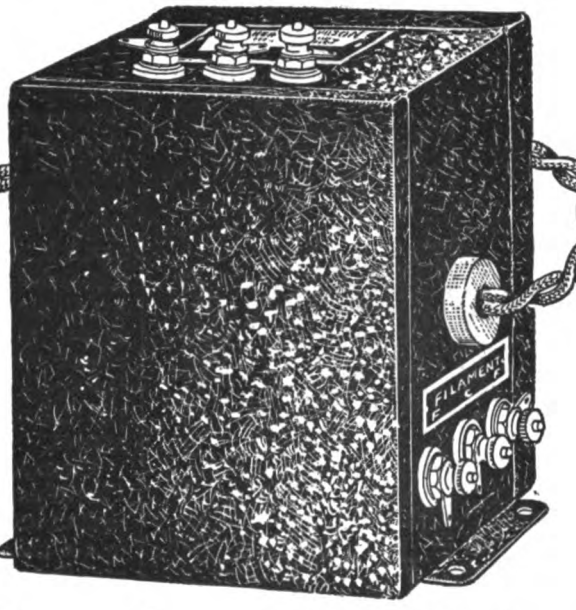

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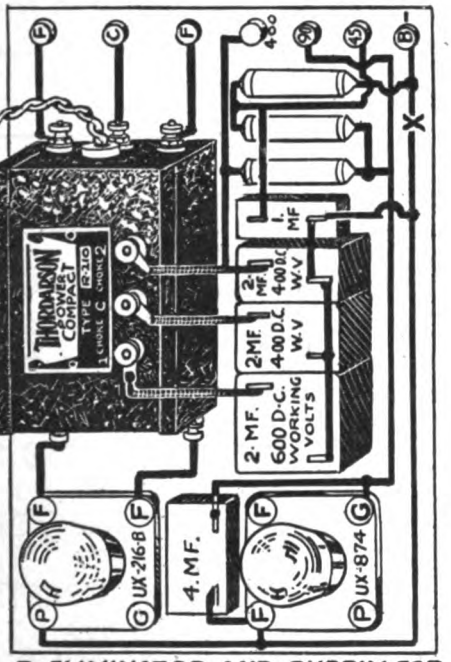

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Is This a Clue to Useful Atomic Power?

AN important experiment on the relation between energy and matter—an experiment which may prove, in fact, to be the beginning of the long-expected conquest of atomic power—was carried out recently in Berlin by two German physical chemists, Dr. Fritz Paneth and Dr. Kurt Peters.* As yet, the experiment is the promise of atomic power rather than the actuality. Nevertheless, it is agreed by scientists that if this experiment is confirmed by repetitions which are now being made by Dr. Paneth at Cornell University it will constitute a significant probability that the supply of useful power in the world will ultimately be increased from atomic sources.

The experiment itself was simple. Dr. Paneth and Dr. Peters pumped a certain amount of very pure hydrogen gas into a glass container in which was a quantity of finely divided palladium. Palladium is one of the metals of the platinum group. When precipitated from its solutions in ways well-known to chemists, the palladium is obtained, not in its ordinary metallic form, but in the form of a very finely divided black powder. It has long been known that this powdered palladium is able to absorb and retain volumes of gases vastly greater than its own volume. Hydrogen is absorbed with especial readiness. It has been imagined that the gas so absorbed is probably condensed in the form of thin, but almost solid films on the surfaces of the tiny particles of the palladium powder.

In the experiment of Dr. Paneth and Dr. Peters all that they did was to leave the hydrogen gas in contact with the metallic palladium for a time. On then pumping out the hydrogen once more and testing it with a spectroscope, the German scientists discovered the presence in the gas of a small amount of helium. This had not been there previously.

All of the probable sources of error having been watched for or corrected, Dr. Paneth and Dr. Peters concluded that what happened was a transformation of some of the atoms of hydrogen into atoms of helium. This transformation was induced, they assume, by mere contact with the metallic palladium, this being an example of the phenomenon of catalysis, the well-known ability of certain finely-divided metallic powders and other substances to bring about chemical or physical changes in which the powdered catalyst itself takes no part.

The importance of this particular atomic transmutation for the matter of atomic power lies in the fact that this transformation of hydrogen into helium

*"On the Transformation of Hydrogen into Helium" (In German), by Fritz Paneth and Kurt Peters. *Die Naturwissenschaften* (Berlin), volume 14, pages 956-962 (October 22, 1926).

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for His New

"KH-27" Receiver

Kenneth Harkness Uses

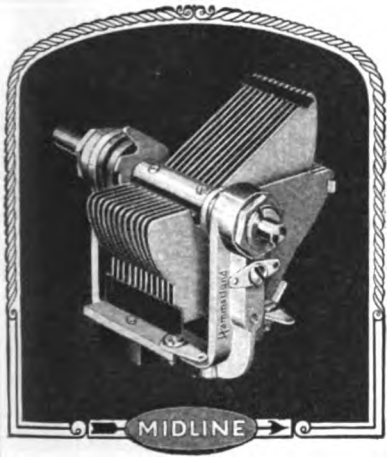
HAMMARLUND Condensers & Coils

The interesting Harkness receiver described in POPULAR RADIO employs one of the fifteen outstanding circuits of the season, for which Hammarlund Precision Products are officially specified by the designers.

Could there be more convincing testimony to the excellence of Hammarlund design and workmanship?

In addition to supreme efficiency Hammarlund Condensers and Coils have distinctive refinements which commend them to the careful set builder who takes pride in his handiwork. Any radio engineer will tell you that Hammarlund Products typify the best the radio world affords.

To insure permanent satisfaction with your "KH-27" Receiver, build it with the Hammarlund parts Mr Harkness uses.



Hammarlund Products Are Also Officially Specified For These New Circuits:

Cockaday "LC-27"; Lacault "LR-4"; Sargent "Infradyne"; Henry-Lyford; Browning-Drake; Pacent "Ultimax"; Victoreen Super; Loftin & White; Carborundum Super; Morison "Varion"; Haynes "DX-2 Multivalve"; Popular Science Monthly "Powerful"; Hammarlund-Roberts "Hi-Q"; St. James Super.

We shall be pleased to refer to the proper authorities your inquiries about any of these receivers.

HAMMARLUND MFG. CO.
424-438 W. 33rd Street, New York City

For Better Radio
Hammarlund
PRECISION
PRODUCTS

is precisely the one previously selected by physicists as the transformation most likely to occur easily and to set free some energy. Indeed, it is now assumed by most of the investigators of the physics of the stars that this transformation of hydrogen into helium is probably occurring in the interior of these celestial bodies, including our own sun, and probably constitutes the source of energy for these great heavenly power-houses.

The energy does not come, as in the case of radium, from any explosion of the atoms of hydrogen, but rather from the condensation of these atoms into heavier atoms. One helium atom weighs a little less than four atoms of hydrogen. It is assumed, therefore, that four hydrogen atoms combine to produce one helium atom and that in so combining they lose a tiny fraction (about three-fourths of one percent) of their combined weight. It is this weight (scientifically called "mass") which is supposed to be converted into energy. Modern physical theories, including, notably, the Einstein theory of relativity, indicate that conversion of matter into energy in this fashion would produce quantities of power which are enormous according to usual human standards. For example, if the mass of one teaspoonful of water could be converted entirely into energy, the mass itself disappearing, the quantity of power thus made available would be approximately 100,000,000 horsepower-hours, or enough to operate New York City's largest electric power-house for nearly five days.

In the actual experiment carried out by Dr. Paneth and Dr. Peters this possible development of power was not detected. The percentage of the hydrogen transformed into helium was minute. The evolution of power, if it occurred, was undoubtedly too small to be measured by ordinary procedures. Nevertheless, if the hydrogen-helium transformation occurred at all it must have been accompanied, physicists believe, by the freeing of energy. The mere repetition of the Paneth-Peters experiment will run no power-houses but it may represent the first yielding of the wall of ignorance which has kept us from finding and using the supposed enormous source of useful energy inside the atom.

Since the extension of radio in all its multitudinous possibilities is bound up so intimately with the production, distribution and use of power, any scientific advance which alters the basis of the world's power supply is sure to prove of the greatest effect on radio conditions. Imagine, for example, a vacuum-valve driven by its own atomic power and in which the decomposition of a millionth of one percent of the mass of the filament would operate the tube for a human lifetime.

ALUMINUM IS A NECESSITY IN RADIO

The R. B. Lab. 2-tube receiver, housed in Aluminum, is an example of advanced design. The Aluminum Panel combines shielding with beauty.

TODAY the crowding of the air makes shielding essential. Radio has turned to Aluminum for shielding because its properties permit the effective elimination of many of the hazards to perfect reproduction. ¶By using Aluminum for top, base, size and center interstage shield, the designer of the R. B. Lab. 2-tube Receiver has created an effective combination. The 3/32″ sheet Aluminum Panel is a photographic reproduction of a rare piece of walnut. ¶Hammarlund-Roberts, Silver-Marshall, L. C. 27 and Varion A. C. specify Aluminum for shielding. ¶Alcoa Wing type Aluminum shields prevent interstage interference effectively and economically. ¶Cantype Shields made of Aluminum are fully effective—individually protecting the various stages. ¶Alcoa Aluminum is effective due to its high durability and low electrical resistance. Used for cabinets and Panels Alcoa Aluminum is light, easily worked and is valuable in the most beautiful wood effects.

Here are some of the Applications:

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A Low-frequency Standard for Future Centuries

AT the meeting on November 24, 1926 of the New York Electrical Society, a Society which has the distinction of being the oldest electrical society in the United States, Dr. Edward R. Berry, consulting engineer of the Lynn, Mass. works of the General Electric Company, presented a lecture on his recently developed material, clear fused quartz, in which lecture he pointed out the well-known, but commonly forgotten fact that during the long period of scientific investigation of sound the world of science has never possessed any absolutely permanent standard of sound frequencies. Tones are commonly identified, Dr. Berry recalled, by comparison with a standard tuning fork, the frequency of which has been determined, in its turn, by comparison with previous tuning forks. The ordinary tuning fork, made of metal, is by no means a constant thing. In the course of years the internal crystallization of the metal will change and its pitch, which means its frequency, will change also.

Dr. Berry recalled the story that the higher pitch now used by European musicians had come about through the gradual change of the standard tuning forks used. When music first began to be standardized, so the story goes, the tuning forks were slightly lower in pitch, for each note of the piano, than they are today. These forks were carried around in musicians' pockets and otherwise subjected to wear. This removed a trifle of the metal. The forks rose in pitch. The result is that European orchestras are now pitched higher than they were two hundred years ago.

Although there is no question of this last fact, the story which Dr. Berry quoted, was admitted to be probably apocryphal. Nevertheless, it is unquestionable that we would have difficulties in preserving for future generations the exact pitch of present day music. No metallic tuning fork could be expected to last even so long as a century without some change of pitch.

Dr. Berry described to the Society a new form of tuning fork made of his clear fused quartz, which fork will maintain indefinitely, he asserted, the pitch to which it is tuned. Also, this fused-quartz tuning fork is affected only slightly by temperature, which is not the case with metal forks. On a warm day, for example, a standard metal tuning fork will be pitched appreciably lower than on a cold day.

Quartz plates, cut from natural crystals of this mineral, are now in common use in radio apparatus for maintaining constant standards of radio frequency. Dr. Berry's proposal implies that the same mineral in its clear fused form is likely to constitute the basic unchanging standard of audio-frequency also.

New York Electrical Society

AN AUDIO-FREQUENCY STANDARD FOR A THOUSAND YEARS

Dr. Edward R. Berry, of the Lynn Works of the General Electric Company, is holding a tuning fork made of clear fused quartz, a material which is immune to the gradual changes of pitch suffered by metal forks. Enduring standards of radio-frequency are also provided by quartz, in the form of plates cut from crystals.

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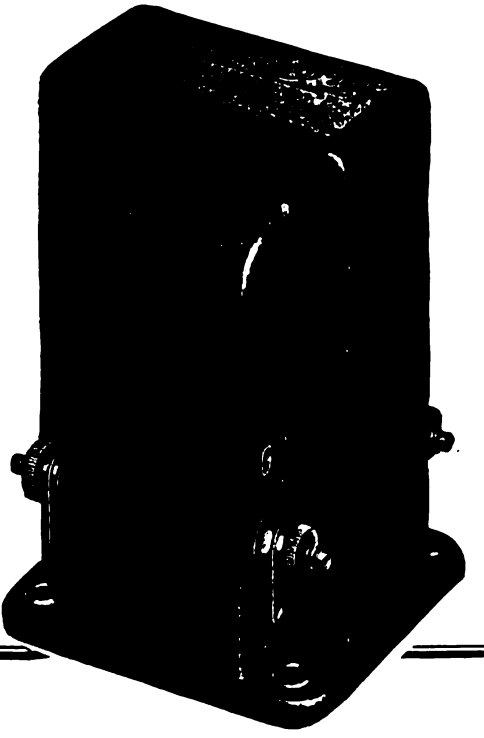
Still the undisputed leader

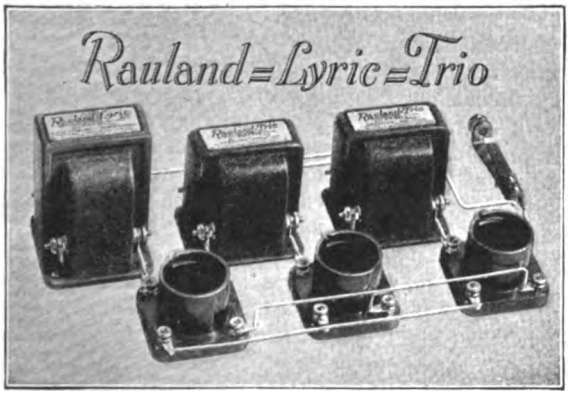
Rauland-Lyric
AUDIO TRANSFORMER



If you love music, and want your radio set to reproduce tones *faultlessly*, there is one audio transformer you can absolutely depend on—the famous Rauland-Lyric.

Voices and instruments alike are amplified with amazing realness by the Rauland-Lyric; with faithful amplification of those "overtones" essential to full, natural reproduction. The amplification curve of the Rauland-Lyric illustrates its outstanding superiority in tone purity.

The Rauland-Lyric is the undisputed leader in its field. It is invariably chosen by set builders who want the utmost in perfect tone quality.



Write for "Modern Audio Amplification", a free book, describing this fine unit.

A new high mark in three-stage audio amplifiers

Your receiver's tone quality depends in large measure on correct audio amplification. The famous Rauland-Lyric Transformer may now be combined with two Rauland-Trios (impedance units) to form the Rauland-Lyric-Trio —the highest known perfection in three-stage audio amplification. Rauland-Trio is a compact, well-made unit — containing in one shell — inductance, resistance, and capacity in correctly balanced relation.

New 1927 Radio Key Book

You'll enjoy reading it—48 pages of interesting, up-to-the-minute facts about radio, simply told. Also full construction details of all leading types of circuits. Send 10 cents (coin or stamps) to cover postage and mailing cost.

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Condensers are the watchdogs—guardians of the receiver or power unit you construct. Assure success by choosing only condensers that stand the gaff!

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BROADCAST LISTENER

Comments on radio programs, methods and technique —from the point of view of the average fan

By RAYMOND FRANCIS YATES

The Gold Star Feature of Last Month

BUT a few weeks back the Breyer Ice Cream Co., one of WJZ's regular and honored customers, exposed a variety show bearing the date of 1890. This was perhaps the most ingeniously managed piece of radio scenario and continuity writing that we have listened to since Paul Stacey of the Eveready Hour microphoned Bill Brown's Lincoln story. There was an unmistakable atmosphere created and that was the atmosphere of the 19th Century variety show—brown derbys, mutton-legged trousers, and horse-hair watch-fobs.

The particular hit that caught our fancy happened to be the lion tamers' act and when this old grouchy admits being entertained by a lion tamers' act on the radio you can bet your pet detector tube, that said lion tamers' act was a wow.

It is no simple matter to create an illusion or atmosphere through the agency of a microphone and when one does hear a good example of it, it's time to get out the gold star and paste it in front of the right name.

* *

One of the Advantages of a Small Ensemble

THE fidelity of transmitted music seems (although we have not consulted our Engineering Department on this point) to be in ratio with the number of instruments or the number of soloists who supply the music.

Much of the music produced by our big symphonies and ensemble is lost in the mechanism of radio, due to the inherent weakness of the microphone and its associated devices. For that reason, a well managed trio (and the Sitig Trio of WOR *is* well managed) offers just about as delightful music as one has the right to expect in these days of radio. Just about every note played manages to squeeze through and that, Kind and Noble Sir, is saying a phonograph full when you get the old slide rules out to show how much of the sound of a symphony gets through as compared with that portion that goes irretrievably to the bow-wows.

* *

What Are Your Ten Favorite Features?

A READER has asked us to name the ten best regular events on the air.

He seems to forget that what is relish for one man is the equivalent of pestilence and mental suffering for another. We can imagine nothing more incongrous than a half-stewed flapper at a ribald Saturday night party being thrown into a fit of ecstacy over Walter Damrosch's concerts. Yet, *we* think them magnificent. The proper appreciation of broadcast features, depends on who you are, where you are and what you happen to be doing.

Our personal list of favorites varies almost from week to week. Right today it includes:

Walter Damrosch
The Eskimos
Henry Hadley's Willys-Overland Hour
The Happiness Boys
The Capitol Theatre Family
The Eveready Hour (not always)
The Atwater Kent Hour (not always)
The Silvertown Cord Orchestra
B. A. Rolfe's Orchestra
The A and P Gypsies

This list, naturally, does not include many excellent features. There is the Ipana Troubadours for instance, and Ben Bernie, Lopez, Cook's Tours, Breyer's Hour and Hohner's Harmony Hour to mention but a few of the more satisfying weekly events that sometimes reach high peaks of excellence.

* *

A Plea for the Use of English in the Studio

TO HEAR some of our quixotic young heroes of the microphone toss off the high-sounding names of foreign composers in French, German and Spanish, one wonders why the mother-tongue cannot in some way be adapted to this use.

This may be a strange, even a crude suggestion, but somehow we cannot overcome the notion that English pronunciation of all foreign names should be practiced in our radio studios and that all members of the radio *intelligentsia* who desire to display their erudition in matters musical should do so in only the presence of their friends and relatives.

For over five years now, we have suffered while our studio boys have been struggling to master those delicate foreign names that so readily and effectually mark the scholar and the wit. At times this ordeal was enough to rupture the patience of a saint, so hot and yet so hopeless did the campaign for perfection become.

Those who are suffering from the Vanity Fair complex quite forget that it is perfectly proper to pronounce foreign words and proper names in English. It is not necessary to call Wagner, "Vog-

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ANYONE CAN BUILD A SET WITH *SIMPLIFIED BLUEPRINTS*

LAURENCE M. COCKADAY has personally supervised the preparation of *Simplified Blueprints* of seven of POPULAR RADIO's most popular circuits. Each set consists of three separate *Actual Size* Blueprints; first a Panel Pattern; second, an Instrument Layout; and third, a Picture Wiring Diagram all simplified in the fullest sense of the word because

The Panel Pattern can be laid on the panel and all holes drilled as indicated. No scaling to do and so accurate there is no danger of ruining the panel through faulty calculation.

The Instrument Layout placed on the sub-base permits you to indicate by pinpricks the exact location of every screw.

The Picture Wiring Diagram gives every instrument in exact size and position with every wire clearly indicated from one contact to the other. With no knowledge of radio symbols you can assemble every part and complete your wiring with no chance of error.

Priced at $1.00 per Set

Set No. 18—"*The Improved Raytheon Power-Pack*" (as described in the May, 1926, issue of POPULAR RADIO).

Set No. 19—"*The New Home Receiver*" (three tubes, two stages of radio-frequency-amplification with crystal detector, as described in June, 1926 issue of POPULAR RADIO.)

Set No. 21—"*The Improved Browning-Drake Receiver*" (as described in the August, 1926, issue of POPULAR RADIO).

Set No. 22—"*The LC-27 Broadcast Receiver*" (as described in the October, 1926, issue of POPULAR RADIO.)

Set. No. 23—"*The LC-Senior Power-Pack*" (as described in the November, 1926, issue of POPULAR RADIO.)

Set No. 24—"*The LC-Intermediate Power-Pack*" (as described in the December, 1926 issue of POPULAR RADIO.)

Set No. 25.—"*The LC-Junior Power Pack*" (as described in the January, 1927 issue of POPULAR RADIO.)

Full constructional and parts details for these Receiving Sets will be found in the issue of POPULAR RADIO indicated. Back issues of POPULAR RADIO will be furnished at the rate of 35c a copy

Popular Radio

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Enclosed is my remittance of $.....for which kindly send me Blueprint Set (s) consisting of Panel Pattern, Instrument Layout and Wiring Diagram as checked below:

☐ **Set Number 18** ☐ **Set Number 22**
☐ **Set Number 19** ☐ **Set Number 23**
☐ **Set Number 21** ☐ **Set Number 24**
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ner" or Chopin, "Showpan" to be correct. Find the German or the Frenchman who bothers to find the proper pronunciation of English words. They promptly give them their own pronunciation and right it is that they should. But here, our scholars and near-scholars consider it a badge of social distinction to be able to roll off a few foreign names no matter how badly they do it. To this class of pretenders, it is nothing short of musical sabotage to sing an opera in English. That is an unforgiveable sin.

What we need in our broadcasting is more and better English and less high school French, German, Spanish and Italian.

* *

A Word About Giving the Names of Composers

AFTER five years of listening to the radio, we stop to wonder how many times we have been informed by gracious and accommodating announcers that Mendelssohn wrote a spring song, Cadman wrote "At Dawning," Chopin wrote an Etude and that Victor Herbert was the composer of "Kiss Me Again." This does not complete the list, but we dare say that our personal score in this radio game of "Who Wrote The Song" runs way, way up into the millions.

All of which makes us ask, is it necessary to name the composer for *each* selection, unless, of course that selection has a common name like "Sonata" or "Humoresque" or "Meditation."

True, there are many selections that bear the name of "Humoresque," in such a case it is necessary to mention the name of the composer. But who, in these loud days of the radio, needs to be informed that Verdi was the father of "Il Trovatore" or that Charlie Cadman must shoulder the guilt for "At Dawning."

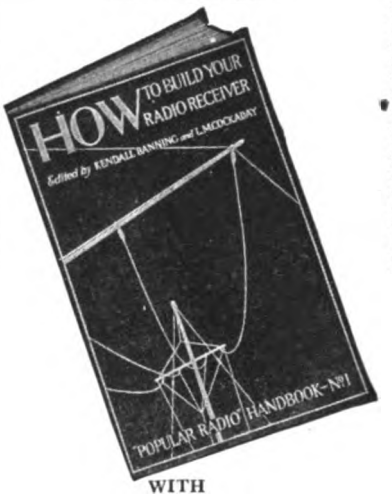
This protest is part of our campaign for better and more simple announcing, announcing without frills or flapdoodle. We want back the good old days when announcements were courteous but short and to the point Mr. So-and-So who gave birth to a popular ditty or dirge is really of small concern to us unless the gentleman was or is a master of his art. And the chances are if he was or is a master of his art we should have heard of him previously.

* *

Too Much Music in One Place

IN its ingratiating bow to the public, The National Broadcasting Company put on what was, without doubt, the most ostentatious program ever released into our great American atmosphere. It was big, it was noisy and it did just exactly what its far-seeing sponsors wanted it to do; it set the tongues of the yokels wagging and it nursed forth a volume of publicity that made a big record.

FREE



WITH

POPULAR RADIO

Aside from the feature of economy, there is the thrill and satisfaction that comes from building your own receiving set.

Thousands of sets have never been constructed because of the atmosphere of mystery that has enveloped the whole subject of radio. Kendall Banning, Editor, and Laurence M. Cockaday, Technical Editor of POPULAR RADIO through their close contact with the great radio public sensed this and compiled a book that will convince the veriest beginner that technical training is not essential. If you have a little time to devote to a most fascinating pastime, send for a copy of "How to Build Your Radio Receiver."

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A Valuable Combination

For the next thirty days we will give you a copy of "How to Build Your Radio Receiver," FREE and enroll you for all privileges of the Technical Service Bureau at no further expense, on receipt of your remittance of $3.00 in payment for a 12 months' subscription for POPULAR RADIO. (As an alternative offer, if you wish the combination with POPULAR RADIO for 7 months only—send but $2.00). In any event, you run absolutely no risk as we will refund in full if you are not more than satisfied with your purchase.

CONTENTS

In "How to Build Your Radio Receiver" you will find complete constructional diagrams, specifications, photographs and instructions for building the following sets. Each has been selected as representative of its circuit because in laboratory tests it proved the best for distance, selectivity, tone volume, simplicity of construction, ease in tuning, reliability and all-around satisfaction.

A $5 CRYSTAL SET

THE HAYNES SINGLE TUBE RECEIVER

A TWO-STAGE AUDIO-FREQUENCY AMPLIFIER

THE COCKADAY 4-CIRCUIT TUNER

A 5-TUBE TUNED RADIO-FREQUENCY RECEIVER

THE "IMPROVED" COCKADAY 4-CIRCUIT TUNER

THE REGENERATIVE SUPER-HETERODYNE RECEIVER

POPULAR RADIO

627 West 43d Street, N. Y. C.

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627 West 43d St., New York City

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City.....State.....

☐ Check here and remit $2.00 if you prefer POPULAR RADIO for 7 months only in combination with "How to Build Your Radio Receiver."

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That there were moments when this program ascended close to Radio Heaven no one will deny.

On the other hand, the honest critic and the sincere connoisseur of broadcasting must admit that it at times did considerable floundering about and that, to even the most casual listeners, it presented something of the spectacle of a big, overgrown musical circus, that was being run off without much attention to details and certainly with no respect for the tenants of better broadcasting. It was one of those programs that could have been put on by any smart young studio shiek providing he was handed $50,000 and told to go on the open entertainment market and spread himself. Such a fellow pounces naturally on big names and big publicity.

Mary Garden was heavy artillery for the front page, but she was the musical equivalent of last years derby when she sang. It requires only money and certainly no talent to hire Will Rogers.

We have no desire and no motive to minimize this colossal program; it was an enormous event. But its price tag stuck out on it like the trade mark on a can of beans. It was made up of the kind of talent that gets publicity in this land of ours, and as a publicity producer it was far more valuable than as an agency for entertainment.

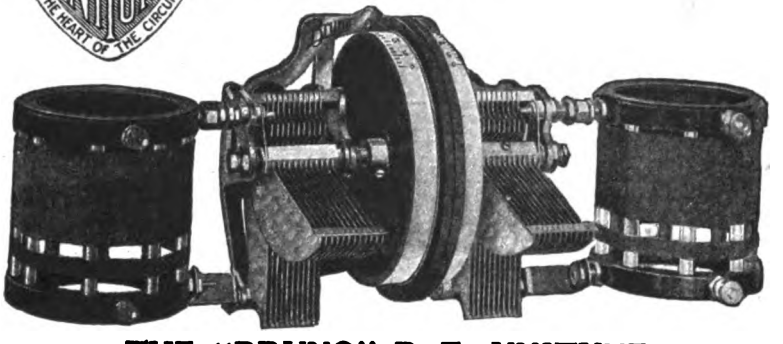
It is conceivable that a man gifted in musical matters as they appeal to the taste of the masses, could have assembled a program that would have cost less than a third of $50,000 and that, although not such an abundant producer of front page stories, would have been much more enjoyable.

Of course we are not so stupid as to think that this mammoth performance did not do a deal of good for broadcasting. It did, by its sheer weight of publicity value. In this it merely followed the prescribed way that we have of doing things here in America. Like George Bernard Shaw, everybody considers the "cart and the horn" before they weigh intrinsic value. Big money, big names and ten cents worth of judgments are the essentials.

We had still another fault to find with this gala event. The young man who did the planning failed to consider the effect on the microphone of the Oratorical Society recital together with the Philharmonic. Never before has the microphone been called upon to swallow such an appalling complication of sound frequencies. As a matter of honest fact, the microphone did not swallow all of them due, it seemed, to a bad case of nausea. At this point the program simply overstepped itself technically as well as otherwise, and while this high-priced noise-making might have made a heavy impression on the country at large, it caused mutterings at the listening posts of those who really know good transmission when they hear it.

"Bruno" UNITUNE THE HEART OF THE CIRCUIT

The Most Desirable Tuning Device Ever Designed For Set Builders!



THE "BRUNO" R. F. UNITUNE
Mounts Panel with only two screws

The basic "BRUNO" UNITUNE is constructed on an aluminum frame upon which are mounted two .0005 mfd. straight line frequency condensers which operate independently of each other through the medium of a pair of moulded bakelite drums whose knurled edges and graduated scales project through the front of the panel and a magnificent bronze plate. *These drums work alone or together.* No other condensers necessary. This UNIT may be purchased in all capacities, completely assembled for $11.00.
ALL OTHER "UNITUNES" assembled with one or more Quartzite Coils for all popular circuits range in price from $12.00 to $21.00.

Send 25 cents for booklet of Instructions and blueprints.

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SETS ARE EASIER TO BUILD IF YOU USE SIMPLIFIED BLUEPRINTS

Every Radio Shop Kit includes a set of full-size Blueprints. An instrument layout shows every part in exact size and position. A picture-wiring diagram shows where and how to connect each wire. By following the wiring plan of the designer your set will perform more efficiently.

A Radio Shop Kit contains everything you need to complete the set, down to the last piece of buss bar and screw. Every panel is machine-drilled and artistically decorated.

A radio set constructed from one of our kits is not only easier for the experimenter to build but its appearance both inside and out, makes it more valuable to you.

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DIAMOND-OF-THE-AIR
5-TUBE KIT—Complete Parts $37.50
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The RADIO SHOP of STAMFORD
20 Worth St., Stamford, Conn.
SERVICE FOR SET BUILDERS

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Gentlemen: Without obligation, send me full information and your prices on the sets before which I have marked X.
I enclose $1.00 for Blueprints of the
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☐ Cockaday's LC-27
☐ Improved Browning-Drake
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☐ PORTABLE TEST BOARD
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A Two-Stage Audio-frequency Amplifier
The Cockaday 4-Circuit Tuner
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POPULAR RADIO maintains a big modern laboratory with a trained staff of investigators under the personal supervision of Mr. Cockaday. This Laboratory is always available through our Technical Service Bureau to answer, free to subscribers, by personal letter any problems you encounter which are not answered in either the "Handbook" or the magazine.

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You can secure a copy of "How to Build Your Radio Receiver" FREE, and have all the privileges of the Technical Service Bureau without additional expense, if you will send a remittance of $3.00 in full payment of 12 months' subscription for POPULAR RADIO. (Or as an alternative, you may have the book and privileges of the Technical Service Bureau with POPULAR RADIO for 7 months only—for $2.00. A two dollar bill will do.)

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BROADCASTS

CONDUCTED BY CHARLES L. REESE, JR.

Interference With Broadcasting Recognized as Illegal

WHAT is believed to be the first arrest for interference with radio broadcasting was recently made in Chatanooga, Tennessee where Martin T. Walters, a university student was brought before Federal Judge Hicks charged with broadcasting without a license, operating out of his wavelength and using false call signals. This is the first recognition by the courts that interference with broadcasting may be regarded as detrimental to the general public welfare and to the rights of the broadcaster in particular.

* *

The Effect of Radio Programs on Concert Attendance

THE often predicted "fall of the concert halls" before the competition of radio broadcasting at last threatens to become an actuality in England where the management of Queen's Hall, London's famous musical center, have announced that they cannot hope to draw large enough audiences to meet expenses as long as radio offers concerts for practically nothing, and that they expect to turn the hall into a movie theatre. One bright feature of the situation is that if the general ruin of the concert business follows the failure of Queen's Hall, the concert artists must turn to radio for their livelihood and in this way greatly improve the general level of broadcast music.

* *

A Protest Against a State Censorship of Radio

THE right of a broadcasting station to transmit its own account of news events through its own announcers was hotly contested recently in New York when the State Athletic Commission was reported to have attempted to dictate to station WMSG which men should be assigned to cover the boxing bouts held in Madison Square Garden and also the salary to be paid for the announcing. Although this move is said to have been made to better the quality of the announcing, it is doubtful if many fans would welcome any such assumption of authority by the state, involving, as it is claimed, an encroachment upon the rights of free speech.

* *

A New Transmitter Tube For "Hams"

A TUBE of a new type, that may soon be available for amateur use, has just been made for the Navy. The tube is of a special high-frequency type for use in connection with a piezo-electric control. Durability is another outstanding characteristic of the tube; several are reported to have survived experiments for over 1,200 hours.

* *

The First "Radio Fraternity"

RADIO has been given its first "collegiate" touch by Norman, Oklahoma amateurs who recently formed what is believed to be the first Greek-letter radio fraternity—Alpha Sigma Delta.

* *

Another Government Seeks to Monopolize Radio

THE recent decision of the broadcasting companies of Japan to consolidate and continue operation as one company is said to be the first step towards a radio monopoly in that country which will be directed and controlled by the government.

* *

Two More Countries Plan to License Radio Receivers

THE widespread plan of paying the costs of broadcasting by a license fee on all receiving sets—which has been sporadically suggested in this country—has gained two more advocates in Hong Kong and Peru. In Hong Kong a governmental bill has been introduced that stipulates a yearly fee of $2.50; Peruvian listeners will be required to pay $5.00 semi-annually and the set will be confiscated if the fee is not paid. The United States thus remains practically the only important nation in which listeners must depend upon advertisers to supply them with radio entertainment.

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Question: What is This?

ANSWER: It is a B-Power Unit—a necessity for best radio reception with up-to-date tubes and speakers.

Q. What does it do?

A. It replaces "B" Batteries, and supplies B-current from the light socket at voltages that are known—and for which the tubes were designed.

Q. Where are the Knobs?

A. Why bother with knobs? None are necessary with the B-T method, consequently you do not have to guess at the voltage delivered by the sound of the set. Tuning a set is enough—you don't have to tune this eliminator also.

Q. Can't I measure voltages from ordinary eliminators?

A. Not by any ordinary means.

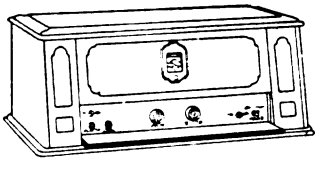
Q. Why should I buy the B-T—there are others cheaper.

A. Also higher—but not better. Your set can't deliver better quality than the current you put into it. When you get a larger set or use power tubes cheap eliminators may fail to deliver sufficient or break down under higher voltages. For every element in our construction there is a cheaper substitute. This unit is engineered and manufactured with the same thoroughness that has made every previous B-T Product an outstanding success. This is your best, in fact, your only assurance. There is less economy in cheap battery substitutes than anything we know of. In this unit you are buying insurance as well as economy and convenience.

Q. Do you build receivers?
A. Yes, the Counterphase.

HERE IS THE "EIGHT" CLOSED

Q. Where are the Dials?
A. There are no dials. Stations are read directly in wavelengths.
Q. But How are the Stations Logged?
A. We do that—using an exclusive patented method. Each set is individually calibrated before shipment.
Q. How Do You Tune?
A. Open the door and turn one knob, which tunes five stages at once.
Q. What is the Rejector?
A. A tuned stage without tube employing a principle never before successfully applied to a radio set. It is exclusively B-T and gives the selectivity which distinguishes the Counterphase from all other single-control sets.
Q. Does "BETTER TUNING" explain the COUNTERPHASE?
A. Yes, fully.



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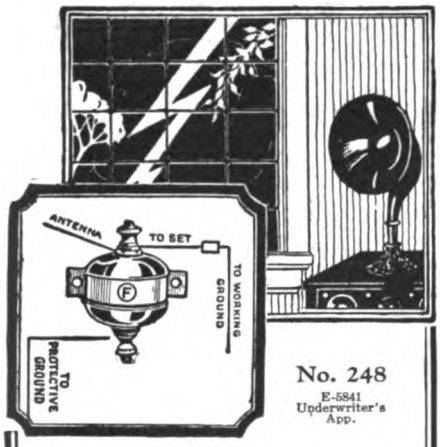

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Used in the Kenneth Harkness-27 6-Tube Hook-up

Used in POPULAR RADIO
IMPROVED
Browning-Drake Hookup
Indorsed by leading radio authorities

Model "N" A slight turn obtains correct tube oscillation on all tuned radio frequency circuits. Neutrodyne, Roberts two tube Browning-Drake, McMurdo Silver's Knockout, etc., capacity range ⅛ to 20-micro-micro farads. Price $1.00.

Model "G" with grid clips obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in heterodyne and positive grid bias in all sets. Capacity range:
Model G-1—.00002 to .0001 MFD
Model G-5—.0001 to .0005 MFD
Model G-10—.0003 to .001 MFD
Price $1.50

X-L PUSH POST
Push it down with your thumb, insert wire, remove pressure and wire is firmly held. Releases instantly. Price 15c.

Push Post Panel permanently marked in white on black insulating panel. In box including soldering lugs, raising bushings and screws for mounting, etc. **Price, $1.50**

X-L Radio Laboratories 2422 Lincoln Ave. CHICAGO, ILL.

Trans-Oceanic Calls Heard

POPULAR RADIO *has now completed arrangements for forwarding to transmitting amateurs in England, France, Germany, Austria, Ireland and Italy all calls heard (QSL) cards that may be addressed to them by American amateurs care of this magazine. These cards will be delivered through local agents in those countries, who have or can obtain knowledge of the present address of the foreign amateurs. Plans have also been completed by this magazine for forwarding to transmitting amateurs in this country in turn all QSL cards that may be addressed to them by amateurs from those countries. American amateurs are invited to send their cards to foreign amateurs through this office, which will not only assure safe delivery through the special agencies which are thus provided, but which will publish a monthly list in a "Trans-oceanic Calls Heard" department.*

Address your cards to the foreign amateurs by call numbers and enclose them in envelopes to—

The Calls Heard Editor,
POPULAR RADIO
627 West 43d Street, New York

THE following stations were received and logged at the amateur receiving station of J. Thomas (R-274) at 3 Avenue des Chalets, Paris 16me, France on an 0-v-1 Reinartz receiver using a single-wire antenna eight meters long and no ground.

U-3JO—Nov. 20, 1926; signal strength R6; steady, rectified AC note, 600 cycles, almost pure DC; no fading.

U-3AY—Nov. 20, 1926; signal strength R5; steady AC note; easily read; no fading.

U-3BMS — Nov. 20, 1926; signal strength R4 to R5; good, steady DC note; no fading.

U-8AMU — Nov. 20, 1926; signal strength R4; good, steady, rectified AC note; no fading.

U-1CJH—Nov. 20, 1926; signal strength R5; good, steady, rectified AC note; no fading.

THE following stations were received and logged at the amateur receiving station of Charles Pavy (R-244) at 10 Rue de la Republique, Arras, Pas de Calais, France on an 0-v-1 Bourne receiver using two cage antennas, nine meters long and fourteen meters high with a cage lead-in and a water-pipe ground.

U-2AOS—Nov. 15, 1926; signal strength R4; calling CQ; rectified AC note; no fading; interference R5.

U-5EV—Nov. 18, 1926; signal strength R5; calling CQ; rectified AC note; no fading.

U-3BWT — Nov. 16, 1926; signal strength R5; calling CQ; rectified AC note; no fading.

THE following stations were received and logged at the amateur station of C. S. Bradley (G-2AUX), 10 Montenotte Road, London, N. 8, England, on a Hartley receiver with a detector and one stage of audio using a single-wire antenna 30 feet high and 40 feet long.

U-2CFT—Nov. 7, 1926; signal strength R3; calling A-7CW on 38 meters; very good DC note; no fading.

U-8CT—Nov. 7, 1926; signal strength R5; calling CQ on 35 meters; very rough AC note; no fading.

RADIO PROBLEMS SOLVED

POPULAR RADIO maintains for the benefit of its readers a Technical Service Bureau and Laboratory, under the personal supervision of Laurence M. Cockaday which will, without charge, answer by personal letter any question, problem or request for information submitted by a subscriber. This service is, however, also available to readers, other than subscribers, at the very nominal rate of $1.00 the inquiry.

In writing please confine your questions to one general subject, writing on one side of the paper only, and enclose a self-addressed and stamped envelope.

It is possible that your individual problem has been covered in an issue of POPULAR RADIO, and so as an aid to you we endeavor to keep a supply of back numbers in stock. The condensed index below gives a few of the subjects that have appeared recently, look this list over and if the information you want is covered, we will be pleased to supply back numbers at 35c. a copy.

February, 1926
—How to Reduce Distortion in Amplification.
—Some Stunt Sets.
—Important Kinks in Wiring.
—How to Cut Down Your "B" Battery Bill.
—Hints for Amateurs.

March, 1926
—Why and How the Milliammeter Increases the Efficiency of Your Set.
—What "Inductance" Really Is.
—List of Broadcast Stations in the U. S.
—How to Build the S-C Receiver for Short and Long Waves.

April, 1926
—How to Get an Operator's "Ticket."
—What a Straight-line Frequency Condenser Really Is.
—How to Build a Power-pack Amplifier.
—The New "Crystal Pilot"
—How to Build and Operate a Low-Power Transmitter.
—The POPULAR RADIO Medal for Conspicuous Service.

May, 1926
—How to Draw Up Your Own "Tuning Graphs."
—How to Build the Improved Raytheon Power-pack.
—How to Build an Antenna Mast for $15.00.
—Fifteen Ways to Reduce Static.
—Do Your Coils Broadcast?

June, 1926
—How to Build the New Home Receiver.
—How to Put Up a Good Outdoor Antenna.
—How to Get the Most Out of Your Ready-made Receiver.
—Audio-frequency Amplification. How to Get It Without Distortion.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.

July, 1926
—How to Get the Best Reception in Summer.
—The Best Crystal Set for $13.00.
—How to Build the Newest Portable "Town and Country" Receiver.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.
—How to Get the Most Out of Your S-C Receiver.

August, 1926
—A New Method of Using Harmonics for Determining Frequencies.
—POPULAR RADIO Circuits.
—How to Build the Improved Browning-Drake Receiver.
—How to Pick Out a Loudspeaker.
—How to Get the Most Out of Your "Town and Country" Receiver.
—Three Vacuum Tubes in One.

September, 1926
—Foretelling Radio Reception from the Weather Map.
—How to Build an Impedance-coupled Amplifier.
—A Radiant Crystal Pilot.
—POPULAR RADIO Circuits.
—How to Simplify Your Set with Automatic Filament Controls.
—Inside Information on New Radio Receivers.
—How to Wire Your House for Radio.

October, 1926
—How to Build the New LC-27 Receiver
—The Radio Road Hog
—POPULAR RADIO Circuits
—Sets That Earn Incomes.
—Inside Information on New Radio Receivers.
—Why Signals Fade.

November, 1926
—How to Build the LC-Senior Power-Pack.
—Waves and Wavelengths.
—POPULAR RADIO Circuits.
—How to Select Your Radio Parts.
—How to Patent Your Radio Inventions.
—How to Solder.

December, 1926
—Uncle Sam's New Short-Wave Net.
—How Circuit Resistance Affects Selectivity.
—POPULAR RADIO Circuits.
—How to Build the LC-Intermediate Power Pack.
—Inside Information on New Radio Receivers.

January, 1927
—How to Build the New KH-27 Receiver.
—To Start and Stop Your Set Automatically.
—POPULAR RADIO Circuits.
—The Quack Doctors of Radio.
—How to Build the LC Junior Power-pack.

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U-9DNG—Nov. 7, 1926; signal strength R3; calling Z-3AJ on 39 meters; very good AC note; no fading.

U-2AJM—Nov. 7, 1926; signal strength R4; calling U-8GM on 38 meters; good AC note; no fading.

U-3CKJ—Nov. 7, 1926; signal strength R3; calling A-2RG on 39 meters; low-pitched AC note; no fading.

U-1CEZ—Nov. 7, 1926; signal strength R7; calling CQ on 40 meters; very good AC note; no fading.

U-4AK—Nov. 7, 1926; signal strength R3; calling F-8FJ on 38 meters; good DC note; no fading.

U-1ADS—Nov. 7, 1926; signal strength R7; calling I-ACD on 39 meters; very good AC note; no fading; heard later calling I-1AU; slight fading; signal strength still R7.

U-2CJE—Nov. 7, 1926; signal strength R5; calling C-4DW on 39 meters; good, steady AC note; no fading.

U-1GA—Nov. 7, 1926; signal strength R4; calling CQ on 39 meters; good DC note; no fading.

U-2AXY—Nov. 7, 1926; signal strength R3; calling CQ on 40 meters; very good DC note; no fading.

U-2AMJ—Nov. 7, 1926; signal strength R4; calling I-1AM on 38 meters; good, steady AC note; no fading.

U-1VZ—Nov. 7, 1926; signal strength R5; calling K-4YAB on 39 meters; very good AC note; no fading.

U-2NZ—Nov. 7, 1926; signal strength R6; calling CQ on 39 meters; rough AC note; no fading.

U-8BTH—Nov. 7, 1926; signal strength R4; calling K-4YAB on 38 meters; rough AC note; slight, regular fading.

U-9ELL—Nov. 7, 1926; signal strength R4; calling M-A9 on 40 meters; very good AC note; no fading.

THE following stations were received and logged at the amateur receiving station of J. Thomas (R-274), 3 Avenue des Chalets, Paris (16), France, on an 0-v-1 Reinartz receiver using a water-pipe antenna and no ground.

U-1BJK—Oct. 30, 1926; signal strength R3; calling F-8FR; good tone; no fading.

U-3JO—Oct. 31, 1926; signal strength R4; calling G-5PZ; steady almost pure AC note; no fading.

U-3BQJ—Oct. 31, 1926; signal strength R3; calling F-8SSW; good, steady DC note; no fading.

U-2CJB—Nov. 13, 1926; signal strength R3 to R4; noticeable fading.

U-1AOF — Nov. 13, 1926; signal strength R4; calling F-8IX; good steady DC note; no fading.

U-2BAD—Oct. 30, 1926; signal strength R3; calling CQ; good, steady, rectified AC note; no fading.

U-8DON — Oct. 30, 1926; signal strength R3 to R5; calling F-8CL; good steady DC note; decided fading.

THE following stations were received and logged at the amateur receiving station of Robert Larcher (R-010), 17 Rue Fessart, Boulogne - Billancourt (Seine), France on a receiver using a vacuum-tube detector and one stage of audio on a 4-meter indoor antenna.

U-8CCS—Oct. 31, 1926; signal strength R4; calling U-8BTB on 37 meters; steady AC note; no fading.

U-2ALM—Oct. 31, 1926; signal strength R4; calling CQ on 38 meters; very steady, pure DC note; slight fading.

U-4AAH—Oct. 31, 1926; signal strength R5; calling CQ on 37 meters; steady, musical AC note; slight fading.

A New Set for Real Fans

Sir Oliver Lodge's famous "N" circuit

ENGLAND'S MOST POPULAR RADIO RECEIVER — MORE SELECTIVE THAN A SUPERHET — USES THE NEW CLEARTRON MULTIVALVE (3 TUBES IN ONE)

ESSENTIAL KIT

A new model of economy. Four tube volume with 2 tubes, including a UX 112 Power tube. Single dial control. Complete descriptive diagram and data for building with each kit. Order yours today.

1 Set of Precision "N" Coils	$6.00
1 Prec. Var. Condenser type "N" .00023 Mfd. Cap.	4.25
2 X-L Variodensers, type G-10	3.00
1 7 x 14 x 3/16 drilled panel	3.50
1 7 x 13½ baseboard	.75
Including diagrams	$17.50

PARTS YOU WILL NEED BUT MAY HAVE

1 Cleartron Multi-valve	$6.50
1 Electrad Royalty Resistance, 500,000 ohms	1.50
1 Electrad Fil. Switch	.40
1 Electrad Double Mtg. with .01 fixed Cond.	1.75
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1 Amperite 6 volt ¼ amp	1.10
1 Amperite 6 volt ½ amp	1.10
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8 Fahnestock clips	.20
2 Pacent Sockets @ 65c	1.30
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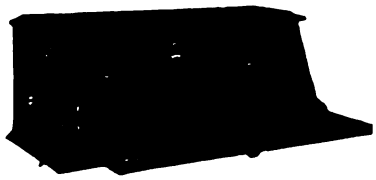
Including diagrams, etc.	$28.55



COCKADAY'S LC-27 BUILT COMPLETE

NOW you can buy the new LC-27 Receiver built complete exactly as Mr. Cockaday's own laboratory model. All you have to do is connect the set with batteries, loud speaker, etc. and tune in. Five minutes from the time you get your LC-27 you can enjoy its matchless quality.

Every LC-27 we build is carefully tested and fully guaranteed. An LC-27 Receiver must function exactly like the original model or it cannot leave our factory.

ONLY $10 EXTRA

It costs only $10 more to buy the LC-27 tested, built complete, and enclosed in the cabinet of your choice. There are three cabinet models from which you can choose. Prices, built complete, are as follows:

With Corbett cabinet, S-20, pictured above, $122.70.
With open front Corbett Cabinet, S-15, $113.20.
With Blandin Cabinet, R-20, $114.70.

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THE NEW K. H.-27

1 K.H.-27 Kit of Essential Parts	$49.50
3 Hammarlund 17-plate condensers (Midline or S.L.F.)	14.25
1 Yaxley Rheostat, 10 ohms	1.35
1 Yaxley Fixed Resistance, 2 ohms	.15
1 Yaxley Battery Switch, Midget type	.50
1 Yaxley Pilot Light Bracket	.50
1 Yaxley Open Circuit Jack, Junior type	.45
1 Yaxley Antenna Switch, Double circuit, Junior type	.85
1 Micamold Grid condenser, .00025 M.F. with G.L. mounting	.45
1 Micamold fixed condenser, .001 M.F.	.40
2 Micamold fixed condensers, .002 M.F.	.80
1 Micamold grid leak mounting	.30
1 Micamold grid leak, 2 or 3 megohms	.45
2 Dubilier 1 MFD Condensers	2.50
2 X-L Variodensers, Type G 1 (.001 Max.)	3.00
4 Amperites (3 Type 1A and 1 Type 112)	4.40
2 Aristocrat Vernier Port Dials	4.00
11 Eby Binding Posts, engraved	1.65
1 6 Volt Lamp for Pilot Light	.50
Total Cost, including diagram	$86.00

THE LC SENIOR POWER PACK

Described in November, 1926, POPULAR RADIO

1—Brach Controlit	$ 6.00
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1—Set POPULAR RADIO Blueprints	1.00
Total Cost	$65.20

Wired complete $7 extra

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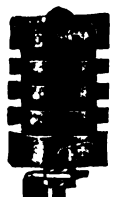
THE PRECISION RADIO FREQUENCY CHOKE COIL

Can be used wherever this type of coil is necessary. Very compact, being one inch in diameter and one and one-half inches long. Can be mounted on a sub-panel or a baseboard. Bracket for baseboard mounting provided with each coil. Has a very low distributed capacity, due to the slotted form of winding. List price $1.00.



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Made in the following capacities particularly for use where high voltage condensers are necessary.

No. 46—4 mfds. DC working voltage 600. Price $9.00.
*No. 26—2 mfds. DC working voltage 600. Price $5.50.
*No. 44—4 mfds. DC working voltage 400. Price $5.50
*No. 24—2 mfds. DC. working voltage 400. Price $3.00.
*Specified for the Senior Power-Pack.

THE ORIGINAL COCKADAY COIL

The only coil ever specified by Laurence M. Cockaday, inventor of the famous Cockaday Four Circuit Tuner for use in his set. The best hard rubber tubing and double silk covered copper wire insures a coil of unusual quality, resulting in increased volume and greater selectivity. Dielectric and leakage losses are extremely low. Price, $5.50.

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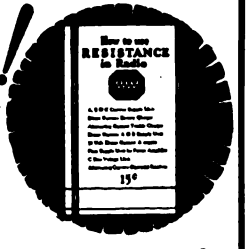
Perfect Tube Performance demands AMPERITE
REG. U.S. PAT. OFF.
The "SELF-ADJUSTING" Rheostat

Amperite alone can give you full value from your tubes. Guarantees perfect filament current control under every condition—automatically. Don't accept substitutes claimed just as good. Insist on Amperite. It is the only automatic, variable filament resistance—and nothing else will do. Eliminates hand rheostats. Simplifies wiring. Price $1.10 mounted (in U. S. A.). Sold everywhere.

RADIALL COMPANY
52 Franklin St.
New York

How to use Resistance in Radio!



Send for this new booklet!

Ward Leonard Electric Company announces a booklet of interest to radio dealers, experimenters, and engineers.

Resistance assumes major importance in radio as higher voltages and currents are employed in power supply units.

"How to use Resistance in Radio" tells the proper use of resistance and outlines many of the new A.C. and D.C. power circuits. It will be sent postpaid for 15c.

Ward Leonard Electric Company
Mount Vernon New York
Resistor Specialists for More Than 35 Years
7135-3

U-8BN—Oct. 31, 1926; signal strength R3 to R4; calling CQ on 37 meters; steady AC note; slight fading.

U-4IW—Oct. 31, 1926; signal strength R4; calling CQ on 38 meters; very steady pure DC note; slight fading; much interference.

U-2TP—Oct. 31, 1926; signal strength R5; heard answering CQ-DX from F-8JF; rough AC note, very steady; no fading.

U-9BAZ—Oct. 31, 1926; signal strength R4 to R5; calling CQ on 38 meters; rough, double AC note; slight fading.

U-3LW—Oct. 31, 1926; signal strength R5 to R7; calling K-4YAC on 37 meters; clear, steady AC note; decided fading.

U-1AKM—Oct. 31, 1926; signal strength R5; calling G-6YD on 38 meters; steady AC note; no fading.

U-8CEO—Oct. 31, 1926; signal strength R6; calling CQ on 40 meters; steady AC note; no fading.

U-3NR—Oct. 31, 1926; signal strength R5; signing off on 39 meters; steady, clear AC note; slight fading.

U-9ARA—Oct. 31, 1926; signal strength R3; calling CQ on 37 meters; clear, steady AC note; slight fading; much interference.

U-2CFT—Oct. 31, 1926; signal strength R6; calling G-2KZ on 37 meters; very steady AC note; slight fading; much interference.

U-1CMX—Oct. 31, 1926; signal strength R6; calling CQ-DX on 37 meters; clear, steady AC note; no fading.

U-1XV—Oct. 30, 1926; signal strength R5; in communication with I-1MA; steady pure DC note; slight fading.

Megaphoning Programs from Airplanes

A NOVEL medium of publicity has been opened by the completion of a radio experiment by Harry F. Paar, operator of commercial broadcast station K-WCR in Cedar Rapids, Iowa.

Mr. Paar mounted a specially constructed receiver on a Waco airplane and equipped it with a Magnavox telemegaphone, secured to the side of the ship. Programs are picked up from various points while the plane is in flight and are megaphoned through the loudspeaker. Clarity of tone from the ship show little change as the elevation of the ship ranges from 400 to 1600 feet. By use of a portable superheterodyne receiver and the telemegaphone it is planned to have the ship circle over outlying towns and megaphone programs put on the air by station K-WCR.

* *

Cuba and Mexico Sign a Radio Treaty

AN international radio system has been provided for in a treaty which has been recently signed by the representatives of the governments of Cuba and Mexico by which the radio systems of the two countries are to be connected. The treaty provides for three classes of service; official service, messages in connection with the operation of the system, and public messages. The official messages are to be carried free, and all of the profits of the international service are to be divided equally between the two countries.

Build Your LC-27 Receiver
by the aid of
Popular Radio
SIMPLIFIED
Blue Prints

Easy, Quick and Accurate

POPULAR RADIO believes that this new circuit; which is the outstanding contribution of Laurence M. Cockaday to the experimental set-builder for this year, constitutes not only one of the most important advances that has so far been made in the radio art, but that it is distinguished by a tonal quality—particularly in the lower registers—that is unsurpassed.

This receiver embraces the 14 points of an ideal radio receiver to meet the demands of the average man's requirements.

1. A quality of reproduction that is as nearly perfect as possible;
2. A cabinet designed to blend harmoniously with the finest surroundings;
3. Consistently good performance with a minimum of care and attention, once the set is installed;
4. A tuning control so simple that any one may operate the set without special instruction;
5. A selectivity adequate to eliminate interference from stations on adjoining wavelengths;
6. An ability to operate on any type of outdoor antenna or with no antenna at all;
7. A capacity to operate on house current or batteries, as desired;
8. Adequate shielding of parts;
9. A power amplifier and output filter to supply ample volume without distortion;
10. A construction that provides for the use of nationally known tubes and parts that are easily obtainable in any locality;
11. A non-regenerative circuit;
12. A simple construction with a minimum of adjustments;
13. A sensitivity adequate to provide good reception of distant programs;
14. A fool-proof construction.

By using POPULAR RADIO Simplified Blueprints in building your LC-27 Receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory model (see page 199).

If your local dealer cannot supply you with Blueprints of the LC-27 Receiver, they will be sent post-paid upon receipt of $1.00.

A full description of this Receiver, with detailed directions for building, was published in the October 1926, issue of POPULAR RADIO. Send 35 cents for a copy.

POPULAR RADIO
Service Bureau 24-B
627 West 43rd St., New York City

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Build
The Outstanding Circuit of the Year
HENRY-LYFORD
Receiver
With the Deliberately Unbalanced Circuit

This new unbalanced feature gives a tremendous increase in sensitivity without losing selectivity. Were a manufacturer to build this set, with labor, overhead and selling costs which of necessity must be added to material it would easily come within the $300 class.

A Simple Circuit—Easy to Build

Simple instructions are furnished with each complete set of parts and all you need is a screw driver, soldering iron and a pair of pliers.

COMPLETE LIST OF STANDARD PARTS
Carefully packed and fully guaranteed
$69.50

Every Dealer Should have our New CATALOG

This catalog is published by our Kit Service Department, for customers who desire complete parts for all popular circuits.

SENT ON REQUEST
Make requests to Service Dept.

HEINS & BOLET
Wholesale and Retail
44 Park Place New York

Before You Build a Set Get this Catalog of

I. C. A. PANELS & PARTS

FANS! Your set can be made to look and to operate as well as a "factory" set if you build it with I.C.A. Insulation materials. We carry in stock panels for over 70 popular circuits, in hi-gloss Insuline or Bakelite, drilled and decorated by the beautiful Etch-O-Gravure Method, all ready to set up. Or we can furnish you with blanks in Insuline or Bakelite, black and wood finishes, all standard sizes.

I. C. A. PANELS for "Popular Radio" Circuits

Improved Browning-Drake—5 tube; Silver-Cockaday—4-tube; LC-27—5-tube; Daven Bass Note—6-tube; Orthophase—5-tube; Samson T.C.Circuit—4-tube; Reflex Receiver—5-tube; McLaughlin Super-Het—8-tube; Amertran B Supply and Amplifier.

We also furnish Sub-Panels for the above and all other popular circuits.

I.C.A. INSULATION PRODUCTS include, Tubing; Spaghetti Tubing; Rods; Sub-Panel Mounting Brackets; Sockets; Socket Shells; Binding Post Panels; Vernier Dials; Pointer Knobs; Grid Leak Holders; Knife Switches; Three-Stage Resistance Coupled Amplifier; Aerial Insulators, etc.

Don't take substitutes for the genuine I.C.A. Products. If your dealer can't supply you write us direct, Dept. P-3.

INSULATING CO. OF AMERICA, Inc.
59 Warren St. New York City

Changes in the List of Broadcasting Stations in the U. S.

These corrections and additions to the list which was published in the March, 1926, issue of POPULAR RADIO *(together with the changes which have been published in succeeding months) make the list correct as of January, 1, 1927. Further changes will be published each month in this magazine.*

STATIONS ADDED

KFOX	Seattle, Washington	210.0
KGCU	Mandan, North Dakota	285.0
KGDO	Dallas, Texas	285.0
KGDP	Pueblo, Colorado	280.7
KGDR	San Antonia, Texas	240.0
KGEA	Seattle, Washington	345.0
KVI	Tacoma, Washington	242.5
KVOS	Seattle, Washington	333.1
KXL	Portland, Oregon	400.0
WABF	Pringleboro, Pennsylvania	410.7
WBKN	Brooklyn, New York	291.1
WBMC	Woodside, New York	293.9
WDWM	Newark, New Jersey	280.2
WEKD	Philadelphia, Pennsylvania	249.9
WJBZ	Chicago Heights, Illinois	419.3
WKBU	New Castle, Pennsylvania	238.0
WLBG	Petersburg, Virginia	332.3
WLBH	Farmingdale, New York	230.0
WLCI	Ithaca, New York	268.0
WLIB	East Wenona, Illinois	296.9
WMBS	Harrisburgh, Pennsylvania	360.0
WMHA	New York, New York	230.0
WMVM	Newark, New Jersey	475.9
WPAB	Norfolk, Virginia	319.0
WPEP	Waukegan, Illinois	212.6
WRRS	Racine, Wisconsin	360.0
WSYR	Syracuse, New York	352.7
WWPR	Detroit, Michigan	300.0
WWVA	Wheeling, West Virginia	348.6
WRSC	Chelsea, Massachusetts	270.1
WLBA	Philadelphia, Pennsylvania	236.1
KYA	San Francisco, California	399.8
WBET	Boston, Massachusetts	384.4
KGDZ	Decora, Iowa	431.0
WTRL	Midland Park, New Jersey	280.2
KGDY	Oldham, South Dakota	210.0
WLBN	*Portable*	225.4
WLBP	Ashland, Ohio	220.4
WLBQ	Atwood, Illinois	230.6
WLBJ	Cleveland, Ohio	300.0
WLBO	Galesburg, Illinois	243.0
WCOM	Manchester, New York	252.0
WLBR	Belvedere, Illinois	335.0
WMPC	Lapeer, Michigan	222.0
WOKT	Rochester, New York	340.0
WBSO	Wellesley Hills, Massachusetts	242.0
KFCR	Santa Barbara, California	413.0
KGDX	Shreveport, Louisiana	291.1

STATIONS DELETED

KFJC	Junction City, Kansas	218.8
WABQ	Haverford, Pennsylvania	280.7
WEBZ	Savannah, Georgia	263.0
WHBG	Harrisburg, Pennsylvania	230.6
WJBX	Osterville, Massachusetts	280.0
WIBH	New Bedford, Massachusetts	209.7
KFUU	Oakland, California	220.4

CHANGES IN WAVELENGTHS

KFDY	Brookings, S. D., 305.9	*change to*	299.8
KFWM	Oakland, Cal., 315.6	*change to*	325.9
KRLD	Dallas, Tex., 357.1	*change to*	353.0
KSBA	Shreveport, La., 312.6	*change to*	280.7
KWTC	Santa Ana, Cal., 260.7	*change to*	263.0
WCBR	Providence, R. I., 209.7	*change to*	234.2
WCWS	Bridgeport, Conn., 209.7	*change to*	232.4
WEDC	Chicago, Ill., 422.3	*change to*	249.9
WFCI	Pawtucket, R. I., 229	*change to*	258.5
WKBM	Newburgh, N. Y., 215.7	*change to*	285.5
WKBO	Jersey City, N. J., 309.1	*change to*	303.9
WSAR	Fall River, Mass., 254.1	*change to*	322.0
WKBO	Jersey City, N. J., 309.1	*change to*	303.9
WJAR	Providence, R. I., 305.9	*change to*	483.6
WIBW	*Portable*, 220.9	*change to*	215.7
KRLD	Dallas, Texas, 353	*change to*	357.1

CHANGES IN LOCATIONS

KSBA	Kennonwood, La., *change to*	Shreveport, La.
WCWS	Providence, R. I., *change to*	Bridgeport, Conn.

* *

New Radio Beacons Protect Shipping

WITH twelve new radio beacon stations added within a single year, bringing the total number up to 28, the Coastal and Great Lakes shipping of the United States is now said to be better protected than that of any other country.

These radio beacons, which are under the direction of the Government Lighthouse Service, will supply bearings to thousands of ships this year.

Vee Dee ART Metal Panels *for Kits and Sets*

Any Metal Form Finish

For Nationally Famed Kits—Drilled and Decorated
L. M. Cockaday LC-27, $3.70
Browning-Drake Improved, $3.05
Hammarlund-Roberts Hi-Q, $2.70
Silver-Cockaday, Panel and Chassis $4.60
Karas Equamatic, $3.50
Infradyne-Remler Type, $3.75
Bremer-Tully Power Six, $3.05
Citizens Super Panel and Chassis, $6.60
Write for Discounts

Receivers equipped with **Vee Dee** metal art panels will yield the utmost in efficiency, accuracy, durability, beauty and economy.

Vee Dee Metal Panels are finished in beautiful wood grains, bronze duotones and high lighted novelty effects. Precisely drilled to the thousandth part of an inch. Every special panel includes vulcanized fibre bushing for best insulation.

Vee Dee Metal Panels are being adopted as standard equipment by prominent manufacturers of kits and sets.

STOCK METAL PANELS
In all standard sizes. Easy to drill. Retail prices range from $2.15 to $3.55. Beautifully finished and artistically decorated.

Manufacturers—Jobbers
Save money and improve your sets by adopting Vee Dee Metal Art Panels. We co-operate in working out new panel designs. Lowest prices—liberal terms. Write to

THE VAN DOORN COMPANY
160 North La Salle Street : Chicago, Ill.
Factories, Quincy, Ill.

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30 Days Free Trial

Just Out— 1927 Model

Yes Sir! You can put a new 1927 Westingale Radio in your home and use it to your heart's content on 30 Days' Trial. Listen to music, concerts, news, sports, market reports from stations all over the country. Compare it with old style 3 or 4 dial sets costing more, then if not convinced that Westingale gives you the greatest Radio satisfaction and the best value for your money, **you don't have to keep it.**

New ONE Dial Radio

$57.00

Retail Price

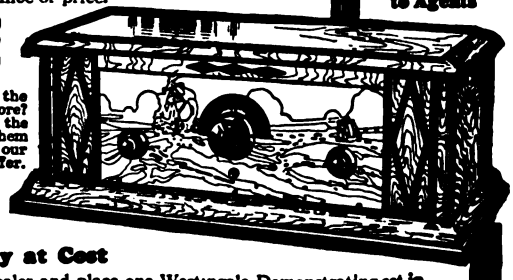
NOW! Westingale offers the last word in Radio. Either 1 or 2-Dial Control — easiest to tune and years ahead in powerful reception and tone. Newest period type cabinets, two-tone walnut finish. The front panel embossed in dull gold with artistic Spanish Galleon design. Unbeatable for performance, appearance or price.

Big Discounts to Agents

2-Dial, 5 tubes $47.00

1-Dial, 5 tubes $57.00

Where else can you get so much for the money on 30 days trial? Why pay more? Why take chances? Why not have the NEWEST Radio when you can try them at our risk. Before you buy get our Free Catalog and 30 Day Trial Offer.



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AGENTS

Make Big Profits — Buy at Cost

We want to appoint agent or dealer and place one Westingale Demonstrating set in each locality. Get demonstrator at big discount in price and on 30 days' trial, and make $50 to $100 a week as our representative. Our Free Book tells how.

Your Own Radio--FREE

Our FREE Catalog also explains a plan whereby you can put a Westingale Radio in your home on 30 Days' Trial—demonstrate it to your neighbors and friends and get your own set without cost. Write for catalog, discounts and complete details today.

Westingale Electric Co., Dept. 144, 1751 Belmont Ave., Chicago, Ill.

New *Vitalitone* Ship Model Cone Speaker

Not a picture, but a real model of a ship sculptured by a foremost artist—and finished in antique polychrome—powered with the wonderful Vitalitone Unit and Cone—We are the pioneer manufacturers of cone speakers—and know what you want—Here it is.

"SUPREME QUALITY AND BEAUTY"

And only $12.50 F.O.B. N. Y.

Your dealer or direct.

Vitalitone Radio Corporation

88 University Place, N. Y., U. S. A.

Outstanding Program Features of the Month

JANUARY 20th TO FEBRUARY 15th

DURING the coming month, January 20th to February 15th, the following regular and special program features are scheduled. This list, which will be augmented monthly as advance information is received, will be published in each issue of the magazine; all broadcast stations are invited to report coming program features of outstanding interest or importance. Reports should reach the Editor of POPULAR RADIO on or before the 23rd of the month preceding.

JANUARY

(Eastern Standard Time)

20th; *Royal Typewriter Orchestra*, WGY; 9:00 P.M. (Also broadcast from WRC, WBZ and WJZ).

20th; *Clicquot Club Eskimos*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ).

20th; *Goodrich Zippers*, WEAF; 10:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WGR, WCAE, WJAR, WTAG, KSD, WOC, WSI, WWJ, WSAI and WADC).

21st; *Happiness Boys*, WEAF; 8:00 P.M.

21st; *Breyer Hour*, WJZ and WRC; 9:00 P.M.

21st; *La France Orchestra*, WEAF; 9:30 P.M. (Also broadcast from WEEI, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).

22nd; *New York Symphony Orchestra with Walter Damrosch*, WEAF; 9:15 P. M. (also broadcast from WEEI, WGR, WFI, WCAE, WWJ, WSAI, WTAM, WGN, KSD, WCCO and WDAF).

23rd; *Capitol Theatre Grand Orchestra*, WEAF; 7:20 P.M. (Also broadcast from KSD, WRC, WWJ, WSAI, WCAE and WTAG).

23rd; *Atwater Kent Hour*, WEAF; 9:15 P.M. (Also broadcast from WSAI, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ and KSD).

23rd; *Godfrey Ludlow*, WJZ; 9:30 P.M. (Also from WGY).

23rd; *Maxwell House Coffee Hour*, WJZ; 10:15 P.M. (Also broadcast from WBZ, WRC, WGY and KDKA).

24th; *Willys-Overland Hour*, WJZ; 8:30 P.M.

24th; *A & P Gypsies*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ).

24th; *Fireside Boys*, WJZ; 9:50 P.M.

24th; *B. A. Rolfe's Palais D'Or Orchestra*, WEAF; 11:00 P.M.

25th; *Classical music, small ensemble*, WRNY; 8:00 P.M.

25th; *Vikings*, WEAF; 8:00 P.M. (Also broadcast from WEEI, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC).

25th; *Jolly Buckeye Bakers*, WEAF; 8:30 P.M. (Also broadcast from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG and WLIB).

25th; *Eveready Hour*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI and WTAG).

25th; *Champion Spark Pluggers*, WJZ; 8:00 P.M. (Also broadcast from WGY and WRC).

25th; *Keystoners*, WJZ; 9:00 P.M. (Also broadcast from WRC and WGY).

25th; *Auction Bridge Instructions*, WEAF; 10:00 P.M. (Also broadcast from WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO, and KSD).

25th; *Cook's Tours*, WJZ; 10:00 P.M. (Also broadcast from WRC and WGY).

25th; *George Olsen's Orchestra*, WJZ; 10:45 P.M.

26th; *Eastman Theatre Orchestra*, WJZ; 6:30 P.M. (Also from WHAM).

26th; *Davis Saxophone Octette*, WEAF; 8:30 P.M. (Also broadcast from WEEI, WJAR, WLIT, WRC, WTAG and WCAE).

26th; *Sixty White Minutes*, WJZ; 9:00 P.M. (Also broadcast from WBZ, KDKA and KYW).

26th; *Ipana Troubadours*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).

26th; *Smith Brothers*, WEAF; 10:00 P.M. (Also broadcast from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO, and WDAF).

27th; *Royal Typewriter Orchestra*, WGY; 9:00 P.M. (Also broadcast from WRC, WBZ and WJZ).

27th; *Clicquot Club Eskimos*, WEAF; 9:00 P.M. (Also broadcast from WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ).

27th; *Goodrich Zippers*, WEAF; 10:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSI, WWJ, WSAI and WADC).

28th; *Happiness Boys*, WEAF; 8:00 P.M.

28th; *Hohner Harmony Four*, WEAF; 8:30 P.M. (Also broadcast from WEEI, WLIT, WGR, WRC, WCAE, WLIB, WTAM and WWJ).

28th; *Breyer Hour*, WJZ and WRC; 9:00 P.M.

28th; *La France Orchestra*, WEAF; 9:30 P.M. (Also broadcast from WEEI, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).

29th; *New York Symphony Orchestra with Walter Damrosch*, WEAF; 9:15 P.M. (Also broadcast from WEEI, WGR, WFI, WCAE, WWJ, WSAI, WTAM, WGN, KSD, WCCO and WDAF).

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Build a 3 ft. Cone Speaker as fine as any you can buy

—SAVE 4/5 Retail Price

A 3 ft. Cone Speaker, which you can build in one evening at home, with PENN Cone Speaker Unit will give as fine TONE QUALITY as a factory-built speaker costing 5 times as much.

"Received material and have completed speaker. Sure is fine. Thank you," writes R. Hanson, Joliet, Ill.

"Never have heard its equal." "Have built 6 and they are simply wonderful." "Really enjoyed reception for the first time," are other comments.

Complete, detailed, easy-to-follow instructions will let you get same satisfactory results. It takes just as long to build a 3 ft. speaker using a less satisfactory unit as it does to build one using the

Penn CONE SPEAKER UNIT

which costs very little more. A marvel of design and construction; adjustable to the audio output of set with which speaker is used; so sensitive it works with any set that will operate a loud speaker. Magnet, pole pieces and armature are plated to prevent rust, preserve magnetism; shortest, strongest drive rod on any unit; full 16 oz. horse-shoe magnet; will take all volume the tubes will pass. Unit only, $9.50.

Complete parts—including 2 sheets Alhambra FONOTEX, Back Rings, Unit Mountings, Ambroid Cement and Unit—only $14.15.

Ask your dealer for the genuine PENN *Cone Speaker Unit and complete parts. If he cannot or will not supply you, we will ship on receipt of price. Pamphlet,* "How to Build a 3 ft. Cone Speaker" *sent for 10c, coin or stamps. Write today.*

PENN RADIO SALES COMPANY
104 FIFTH AVE. *Suite 2196* NEW YORK CITY
Exclusive Selling Agents for G. R. PENN MFG. CO., N. Y. C.

DEALERS: Your customers are reading the above advertisement and acting on it. You can sell these demanded items. Write us for full information.

Build Your Improved Browning-Drake with Popular Radio SIMPLIFIED Blue Prints

Easy, Quick and Accurate

The Improved Browning-Drake Broadcast Receiver, designed by Arthur H. Lynch, former Editor of Radio Broadcast and built and approved in the POPULAR RADIO LABORATORY.

Here is a receiver which combines all the advantages of a circuit that has long been recognized as standard with new ideas and improvements which have been made in receiver construction since the circuit was first designed.

High efficiency that emphasizes fine tone quality is the outstanding characteristic of this new model.

By using POPULAR RADIO Blue Prints in building your Improved Browning-Drake Broadcast Receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory model (see page 104).

If your local dealer cannot supply you with Blue Prints of the Improved Browning-Drake, they will be sent postpaid upon receipt of $1.00 per set.

A full description of this set, with detailed directions for building, was published in the August, 1926, issue of POPULAR RADIO. Send 35c for copy.

POPULAR RADIO
Service Bureau 24-C
627 W. 43rd St., New York City

30th; *Capitol Theatre Grand Orchestra*, WEAF; 7:20 P.M. (Also broadcast from KSD, WRC, WWJ, WSAI, WCAE and WTAG).
30th; *Atwater Kent Hour*, WEAF; 9:15 P.M. (Also broadcast from WSAI, WEEI, WFI, WCCO, WTAM, WGN, WFI, WCAE, WGR, WOC, WTAG, WWJ, and KSD).
30th; *Godfrey Ludlow* (violinist) WJZ; 9:30 P.M. (Also from WGY).
30th; *Maxwell House Coffee Hour*, WJZ; 10:15 P.M. (Also broadcast from WBZ, WRC, WGY and KDKA).
31st; *Willys-Overland Hour*, WJZ; 8:30 P.M.
31st; *A & P Gypsies*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ).
31st; *Fireside Boys*, WJZ; 9:50 P.M.
31st; *B. A. Rolfe's Palais D'Or Orchestra*, WEAF; 11:00 P.M.

FEBRUARY

1st; *Classical music, small ensemble*, WRNY; 8:00 P.M.
1st; *Champion Spark Pluggers*, WJZ; 8:00 P.M. (Also broadcast from WGY and WRC).
1st; *Vikings*, WEAF; 8:00 P.M. (Also broadcast from WEEI, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAE, WCCO and WOC).
1st; *Jolly Buckeye Bakers*, WEAF; 8:30 P.M. (Also broadcast from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG and WLIB).
1st; *Eveready Hour*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI and WTAG).
1st; *Keystoners*, WJZ; 9:00 P.M. (Also broadcast from WRC and WGY).
1st; *Auction Bridge Instructions*, WEAF; 10:00 P.M. (Also broadcast from WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO and KSD).
1st; *Cook's Tours*, WJZ; 10:00 P.M. (Also broadcast from WRC and WGY).
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2nd; *Eastman Theatre Orchestra*, WJZ; 6:30 P.M. (Also from WHAM).
2nd; *Davis Saxophone Octette*, WEAF; 8:30 P.M. (Also broadcast from WEEI, WJAR, WLIT, WRC, WTAG and WCAE).
2nd; *Sixty White Minutes*, WJZ; 9:00 P.M. (Also broadcast from WBZ, KDKA and KYW).
2nd; *Ipana Troubadours*, WEAF, 9:00 P.M. (Also broadcast from WEEI, WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).
2nd; *Smith Brothers*, WEAF; 10:00 P.M. (Also broadcast from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF).
3rd; *Royal Typewriter Orchestra*, WGY; 9:00 P.M. (Also broadcast from WRC, WBZ and WJZ).
3rd; *Clicquot Club Eskimos*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ).
3rd; *Goodrich Zippers*, WEAF; 10:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSAI, WWJ, WSI and WADC).
4th; *Happiness Boys*, WEAF; 8:00 P.M.
4th; *Breyer Hour*, WJZ and WRC; 9:00 P.M.
4th; *La France Orchestra*, WEAF; 9:30 P.M. (Also broadcast from WEEI, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).
5th; *New York Symphony Orchestra with Walter Damrosch*, WEAF; 9:15 P.M. (Also broadcast from WEEI, WGR, WFI, WCAE, WWJ, WSAI, WTAM, WGN, KSD, WCCO and WDAF).
6th; *Capitol Theatre Grand Orchestra*, WEAF; 7:20 P.M. (Also broadcast from KSD, WRC, WWJ, WSAI, WCAE, WTAG).
6th; *Atwater Kent Hour*, WEAF; 9:15 P.M. (Also broadcast from WSAI, WEEI, WFI, WCCO, WTAM, WGN, WFI, WCAE, WGR, WOC, WTAG, WWJ and KSD).
6th; *Godfrey Ludlow* (violinist), WJZ; 9:30 P.M. (Also from WGY).
6th; *Maxwell House Coffee Hour*, WJZ; 10:15 P.M. (Also broadcast from WBZ, WRC, WGY and KDKA).
7th; *Willys-Overland Hour*, WJZ; 8:30 P.M.
7th; *A & P Gypsies*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ).
7th; *Fireside Boys*, WJZ; 9:50 P.M.
7th; *B. A. Rolfe's Palais D'Or Orchestra*, WEAF; 11:00 P.M.
8th; *Classical music, small ensemble*, WRNY; 8:00 P.M.
8th; *Champion Spark Pluggers*, WJZ; 8:00 P.M. (Also broadcast from WGY and WRC)
8th; *Vikings*, WEAF; 8:00 P.M. (Also broadcast from WEEI, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC).
8th; *Jolly Buckeye Bakers*, WEAF; 8:30 P.M. (Also broadcast from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG and WLIB).
8th; *Eveready Hour*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI and WTAG).
8th; *Keystoners*, WJZ; 9:00 P.M. (Also broadcast from WRC and WGY).
8th; *Auction Bridge Instructions*, WEAF; 10:00 P.M. (Also broadcast from WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM

For fine Cone Speakers that you Build or Buy

ALHAMBRA FON-O-TEX, developed *especially* for cone speakers, is used by nearly all the leading makers of fine cone speakers because it produces tone quality far superior to less expensive substitutes.

Alhambra FON-O-TEX is *not* paper but a distinctive product. It has almost no grain, therefore it has no resonance point of its own but resonates uniformly at all frequencies. Practically impervious to atmospheric changes.

Whether you buy a cone speaker or build your own, be sure that the cone is made of Alhambra FONOTEX.

At dealers in 38" x 38" sheets for 3 foot cones. Price 75c. If your dealer will not get Alhambra FONOTEX for you we will ship f. o. b. New York. Add $1 for special packing to the cost of the number of sheets you want.

The SEYMOUR Co.,
Desk 111
325 West 16th Street
New York City

ALHAMBRA
FONOTEX
PRODUCT AND PROCESS PATENTED
FOR CONE TYPE LOUD SPEAKERS

To Manufacturers:

If you are not using it, we can demonstrate that Alhambra FONOTEX will improve the tone of your cone speaker.

DEALERS—Radio constructors from all parts of the country send to us for Alhambra FONOTEX because their dealers do not carry it. Don't lose any more sales; stock Alhambra FONOTEX.

JOBBERS—Write us if we are *not* adequately represented in your territory. We have an interesting proposition.

Flux a factor in Satisfactory Reception

THE importance of the proper flux for radio soldering, has become so significant, that manufacturers of better radio sets have, after extensive laboratory tests, adopted Kester Rosin Core Solder—alert set builders, too, use nothing but Kester Radio Solder, the handy size package of Kester Rosin Core Solder.

Pure rosin, as in Kester Radio Solder, is absolutely non-corrosive and is the only safe flux for radio. Being a hard, dense substance, rosin will not attract and collect dust (carbon particles) which forms a path for leakages. Chloride fluxes in either paste, liquid or compound form are highly corrosive. They absorb moisture from the air, and when heat is applied, a spattering, fuming and spreading action is caused. The areas over which flux is thus spread attract and collect dust (carbon particles) which forms an excellent path for leakages and soon impairs the receptive quality of any set.

Insist upon knowing that the set you buy has been soldered with Kester Rosin Core Solder and be equally sure that you use only Kester Radio Solder on the set you hook up yourself.

A free sample—write for it now

KESTER *Radio* SOLDER
The safe solder and flux for radio
CHICAGO SOLDER COMPANY
4201 Wrightwood Ave.
Chicago, U. S. A.

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Now is The Time you need a Ducon!

When there's sleet and snow and howling winds—that's the time when antenna troubles come. Many is the good program that has been missed while the B.C.L. was trying to make up his mind to tackle the broken antenna on his icy roof.

And that is why every set owner should have a little Ducon handy. Plugged into any light socket it makes an aerial out of all your house wiring without risk. What is more, it gives greater selectivity in crowded areas—gives better results than most outdoor aerials do. And it puts an end forever to the annoyance of a broken aerial.

Good dealers sell the Dubilier Ducon on five days' trial for $1.50. Buy one now and have it handy when you need it—you will probably never want to go back to the old aerial again.

Send 10c in stamps or coin for our new 32 page booklet "Seventeen Ways to Improve Your Set." It will tell you things that only experts know about the use of fixed condensers.

Dubilier
CONDENSER AND RADIO CORPORATION
4377 Bronx Blvd., New York, N. Y.

WFI, WWJ, WSAI, WGN, WOC, WCCO and KSD).

8th; *Cook's Tours*, WJZ; 10:00 P.M. (Also broadcast from WRC and WGY).
8th; *George Olsen's Orchestra*, WJZ; 10:45 P.M.
9th; *Eastman Theatre Orchestra*, WJZ; 6:30 P.M. (Also from WHAM).
9th; *Davis Saxophone Octette*, WEAF; 8:30 P.M. (Also broadcast from WEEI, WJAR, WLIT, WRC, WTAG, WCAE).
9th; *Sixty White Minutes*, WJZ; 9:00 P.M. (Also from WBZ, KDKA and KYW).
9th; *Ipana Troubadours*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).
9th; *Smith Brothers*, WEAF; 10:00 P.M. (Also broadcast from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF).
10th; *Royal Typewriter Orchestra*, WGY; 9:00 P.M. (Also broadcast from WRC, WBZ and WJZ).
10th; *Clicquot Club Eskimos*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ).
10th; *Goodrich Zippers*, WEAF; 10:00 P.M. (Also broadcast from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSI, WWJ, WSAI and WADC).
11th; *Happiness Boys*, WEAF; 8:00 P.M.
11th; *Hohner Harmony Four*, WEAF; 8:30 P.M. (Also broadcast from WEEI, WLIT, WGR, WRC, WCAE, WLIB, WTAM and WWJ).
11th; *Breyer Hour* (orchestra and vocal), WJZ and WRC; 9:00 P.M.
11th; *La France Orchestra*, WEAF; 9:30 P.M. (Also broadcast from WEEI, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).
12th; *New York Symphony Orchestra with Walter Damrosch*, WEAF; 9:15 P.M. (Also broadcast from WEEI, WGR, WFI, WCAE, WWJ, WSAI, WTAM, WGN, KSD, WCCO and WDAF).
13th; *Capitol Theatre Grand Orchestra*, WEAF; 7:20 P.M. (Also broadcast from KSD, WRC, WWJ, WSAI, WCAE and WTAG).
13th; *Atwater Kent Hour*, WEAF; 9:15 P.M. (Also broadcast from WSAI, WEEI, WFI, WCCO, WTAM, WGN, WFI, WCAE, WGR, WOC, WTAG, WWJ and KSD).
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13th; *Maxwell House Coffee Hour*, WJZ; 10:15 P.M. (Also broadcast from WBZ, WRC, WGY and KDKA).
14th; *Willys-Overland Hour*, WJZ; 8:30 P.M.
14th; *A & P Gypsies*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ).
14th; *Fireside Boys* (vocal), WJZ; 9:50 P.M.
14th; *B. A. Rolfe's Palais D'Or Orchestra*, WEAF; 11:00 P.M.
15th; *Classical music, small ensemble*, WRNY; 8:00 P.M. WJZ; 9:50 P. M.
15th; *Champion Spark Pluggers Orchestra*, WJZ; 8:00 P.M. (Also broadcast from WGY and WRC).
15th; *Vikings*, WEAF; 8:00 P.M. (Also broadcast from WEEI, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC.)
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15th; *George Olsen's Orchestra*, WJZ; 10:45 P.M.
16th; *Eastman Theatre Orchestra*, WJZ; 6:30 P.M. (Also from WHAM).
16th; *Davis Saxophone Octette*, WEAF; 8:30 P.M. (Also broadcast from WEEI, WJAR, WLIT, WRC, WTAG and WCAE).
16th; *Sixty White Minutes* (orchestra), WJZ; 9:00 P.M. (Also broadcast from WBZ, KDKA and KYW).
16th; *Ipana Troubadours*, WEAF; 9:00 P.M. (Also broadcast from WEEI, WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).
16th; *Smith Brothers* (vocal and instrumental), WEAF; 10:00 P.M. (Also broadcast from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF).

* *

Antennas Now a Part of Motorboat Equipment

ANTENNA wires strung from the mast to the hull are no longer necessary in the latest type of motorboat which is being provided by the manufacturers with built-in loop antennas that are embedded in the hull when the boat is built.

To Speed Radio Patents

UNDER the supervision of Secretary Hoover, the Radio Division of the U. S. Patent Office has made some rapid strides in cleaning up its unfinished business. Although this Division is the largest in the Patent Office, and has been transferred to the Department of Commerce for only a year, it is but five and one-half months behind its work.

When Secretary Hoover took over the Radio Division of the U. S. Patent Office, no radical changes in administration were made. Instead, a committee of experts was instructed to study the situation and report to the Secretary. The results of the work of this Committee have just been received.

Among some of its recommendations are increased salaries for the technical and scientific employees, with an additional force to handle the clerical work; modern equipment for the office, as well as the construction of a new building; an amendment in statutes governing Patent Office practice, largely covering appeals, making the Patent Office decisions final except as they may be reviewed by a U. S. District Court.

* *

"Diseases" Caused by Radio

NEW diseases with names derived from the radio are progressing fast and unchecked. At first the doctors told us that radio fans suffered from "radio-ears," when it was necessary to wear headphones to tune in distance. Next came "disto-mania," which is self-explanatory, followed by "audio-toxication" and "nocturnal radiophasia."

Of course, these diseases are perfectly harmless unless they become chronic, although they are infectious. The latest ones are "microphobia," which is a word meant to describe the disease-like fear experienced by first-timers, and some old-timers too, when they first appear before the microphone of a broadcasting station.

The newest disease is "microphonitis," which is defined as "a chronic infection which so expands the ego that one is never content except when talking through the 'mike.'"

* *

Starving Trappers Saved by Radio

WHEN the *Bay Eskimo*, supply ship of the Hudson's Bay Company, was crushed in the ice of Hudson's Straits last July, and the relief ship sent to save the men on board failed to reach her, radio was finally turned to as a last resort and proved to be the means of saving the trappers' lives. An appeal for help was broadcast by the company through station WBZ and another hunting post, hundreds of miles away, picked up the call and rushed food by dog sled over the icy wastes to the ship in time to save the marooned men.

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Radio Tells the Time

KEEPING America on time is the latest duty of the radio broadcasters, now that the Western Union and the telephone companies refuse to answer questions about the time. The man without a receiver may be out of luck, but the radio listener will continue to set his watch by the time signals from Arlington or whenever a broadcaster signs on or off.

* *

$1,000,000 for a Broadcast Station

SOME idea of the tremendous value of a modern broadcasting station may be obtained from the price paid for station WEAF which was recently sold to the Radio Corporation of America for one million dollars. A large part of the value of a station of this kind, of course, lies in the good will of its listeners and the fact that it is known from one end of the country to the other.

* *

Radio Telephones on German Express Trains

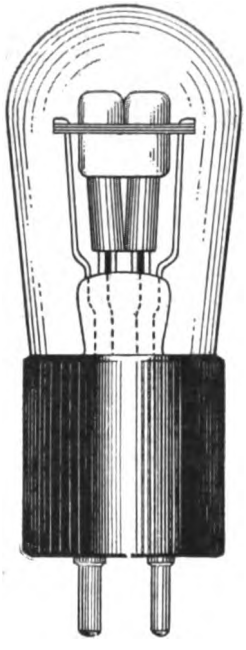
A REGULAR "wired wireless" telephone system by means of which telephone calls may be made between any telephone in Berlin and Hamburg and express trains running between these cities, has been opened to the public after months of experiment. Rates are no higher than for ordinary long distance calls and the transmission is said to be extraordinarily clear. Both the transmitting and receiving antennas are located along the roofs of the Pullman cars; the impulses then travel to telephone wires running along the tracks.

E. B. Harvey, Los Angeles

PARK CONCERTS VIA LOUDSPEAKERS

To Los Angeles belongs the credit for first carrying into effect the plan of broadcasting (from station KNX) concerts to its public parks, through the medium of receiving sets and loudspeaker installations such as is pictured above. The nine installations cost the city a total of $22,675; but the average cost for one band concert in one park used to be $200; now the music of one band is broadcast to the other eight parks.

New Full-Wave Gas Rectifier Tubes



60 Milliamps - - - - - - - - - $6.00
85 Milliamps - - - - - - - - - $6.00

Guaranteed. Made under our own patent applications. We *do not* use the old short path principle.

We also have some news regarding an A, B and C Eliminator without batteries or charger, if you are interested.

Write for dealers' or manufacturers' discounts; or better, order samples for comparison tests.

R. G. Dun or Bradstreets will tell you our guarantee is good.

The Q·R·S Music Company

306 S. Wabash Ave., Chicago

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MODEL "C" CHEST

Cabinets in stock—have piano hinge and are 10" deep — grooved front top rail being removable. Illustration shows gold line wood panel to match.

Sizes	Walnut Only	Panel to Match
7x18-10	$15.00	$1.26
7x21-10	17.00	1.47
7x24-10	19.00	1.68
*7x26-10	21.00	1.82
7x30-10	23.00	2.10
*7x28-11	23.00	1.96

*For Madison-Moore Receiver.
*For Victoreen Receiver.

Walnut Infradyne Cabinet
$30.00

LC-27 Cabinets
Mahogany or Walnut with Baseboard
$18.00

The LC-27 cabinets have 25° slope and take 8" x 26" panel. They are full 10" deep back of the panel.

WRITE FOR folder showing complete LC-27 Line and other Radio Furniture.

CORBETT CABINET MFG. COMPANY
St. Marys - - Pennsylvania

Simplified Blue Prints
of the
"Town and Country"
Portable Receiver

The "Town and Country" Portable Receiver, developed by the POPULAR RADIO LABORATORY and described in the July, 1926 issue, marks a decided advance in portable receiver design. While not a "vest pocket" receiver, the new "Town and Country" is small enough to be taken along on a motor boat or train trip. Efficiency has not been sacrificed for the sake of compactness.

The receiver uses six UX-199 tubes and one UX-120 power tube. Operating on a loop, tone quality is guaranteed by the use of a fundamentally correct circuit, high-class transformers and cone-type speaker.

The "Town and Country" Portable Receiver is mounted in a special mahogany cabinet with a drop front and is equipped with a carrying handle. All equipment, including the folding loop, cone loudspeaker, batteries and connecting cable, is installed in a suitcase. Connections from the equipment to the set are made by means of jacks and plugs.

By using POPULAR RADIO Blue Prints in building your "Town and Country" receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory models (see page 199).

If your local dealer cannot supply you with Blue Prints of this set, they will be sent postpaid upon receipt of $1.00 per set.

POPULAR RADIO
Service Bureau 24-D
627 W. 43rd St., New York City

A Loudspeaker That Is Heard in Two Cities

RADIO shops with their outside loudspeakers have a serious rival now as a purveyor of free music to the people of Camden, N. J., for a monster loudspeaker has been installed there on top of a high building and may be heard all over the city. Such a tremendous amount of amplification is used that the music from the speaker has often been heard in Philadelphia across the river; and on one occasion, traffic was stopped on the new Delaware River Bridge by crowds of people looking for the source of the broadcast.

* *

Let Your Dress Be Your Antenna

FEMININE fans who like to carry their radio with them in the shape of small portable sets will welcome the suggestion made by Felicia Sorel, a dancer, who declares that the gilt tape used for indoor aerials makes an ideal trimming for dresses and a handy loop antenna at the same time.

* *

Have You Ever Heard—

THE canary birds sing in the lobby of the Hotel Commodore during the dinner music broadcast from that hotel through station WJZ?

The tick of the metronome between the selections and announcements from station PWX in Cuba?

The traffic policeman's whistle on the corner of 34th Street and Fifth during the dinner hour concert at the Waldorf-Astoria broadcast through station WEAF?

The lazy southern drawl of the WSB announcer?

The "tweet-tweet-tweet" of the Arlington time signals, rebroadcast through station KDKA?

The "toodle-oo" of the staccatone between the selections at station WRNY?

* *

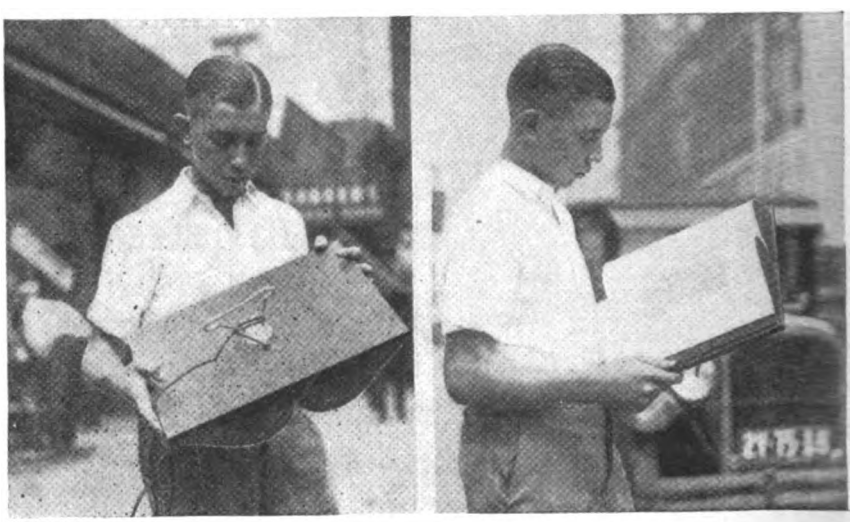
Greece Limits Listening Range for Fans

IT'S no news when a government restricts transmitters to a certain wavelength range but it is unusual for a nation to forbid listeners, as Greece has recently done, to listen in on certain wavelengths. The use of all privately owned receiving sets that are capable of picking up messages transmitted on a wavelength of 2,000 meters or more has been prohibited; owners of such apparatus must have their sets adjusted by the government to receive only the lower wavelengths before they may be used again. Although no explanation has been proffered, it is suspected that the Greek Government plans to use the higher wavelengths for official business and wants to be sure that no one, in Greece at least, will be able to listen in.

* *

British Fans Hear U. S. Programs Nightly

BRITISH air-lanes, according to recent reports from London, are flooded every night now in the early morning hours by programs broadcast by American stations. As soon as darkness has fallen over the full width of the Atlantic, at about 1.30 A.M. Greenwich time, listeners find that they can pick up an astonishing number of American stations that were entirely inaudible during the tests last winter. One fan is reported to have picked up WJZ on a simple three-tube set comprising only a detector and two stages of audio-frequency amplification with such strength that it could be heard on a loudspeaker all over a fair-sized room with good volume.



Herbert

A TALKING BOOK FOR YOUR LIBRARY

The innocent looking volume on the the right is actually a loudspeaker; a metal rod from the speaker unit actuates the pages of the book which reproduce the sound in much the same manner as a cone speaker. The left view shows how the covers of the book have been rigidly mounted on a base; the leaves conceal the speaker unit. Milton Gabler designed and built this curious speaker.

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Engineering Library

Popular Radio

MARCH · 1927 ★

25¢

How to Build a One-Tube Receiver for use with a Loud Speaker—

and

How to Build the Loud Speaker

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BY AIRPLANE OR MULE-BACK

There's a radio station in Honduras, six thousand feet high, upon a mountain top. They use Radiotrons there, high power Radiotrons, for transmission. More than once in an emergency, the Radiotrons have had to be delivered by airplane. Usually they are carried up the rough mountainside by mule-back.

These great Radiotrons cost a few hundred dollars apiece, and as not many "spares" can be kept on hand at that price, each one must perform exactly to standard—each one must be sturdy of build in spite of its delicate accuracy.

The laboratories that design these high power transmission tubes design the Radiotrons you use. The same factories make them. The same test laboratories test them. RCA produces the tubes for all sorts of high power transmission and learns from these tubes many a lesson of making and testing that gives you a better Radiotron for your receiving set! Benefit from this experience by using only genuine RCA Radiotrons, no matter what *type* of tube you use.

RCA

RADIO CORPORATION OF AMERICA
New York Chicago
San Francisco

Every tube in your set counts!

Every tube in your set has its "finger in the pie." The faint signal that comes in from the broadcasting station goes through each tube, and it's magnified hundreds of thousands of times before it gets to the loudspeaker.

It's not only important to get the "special" Radiotrons that give you bigger distance and bigger volume. But it's just as important to stick to genuine Radiotrons straight through the set, if you want to keep up its performance. RCA research makes Radiotrons better and better every year!

Bring your storage battery set up-to-date with
a *power* RADIOTRON UX-171 or UX-112
a *detector* RADIOTRON UX-200-A
and RADIOTRONS UX-201-A for all-round quality.
Bring your dry battery set up-to-date with
a *power* RADIOTRON UX-120
and RADIOTRONS UX-199 for all-round quality.

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA

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NEW!
Eveready Layerbilt "B" Battery No. 486, the Heavy-Duty battery that should be specified for all loud-speaker sets.
No.486
EVEREADY
RADIO "B" BATTERY
Layerbilt
NATIONAL CARBON CO. INC.
The Layerbilt patented construction revealed. Each layer is an electrical cell, making automatic contact with its neighbors, and filling all available space inside the battery case.
DIFFERENT!

For greatest economy all loud speaker sets require the new Eveready Layerbilt "B" Batteries

IT WILL pay you, in convenience and reliability as well as in dollars and cents saved, to use this remarkable battery.

The reason for the Eveready Layerbilt's surprising performance lies in its exclusive, patented construction. No other battery is like it. It is built in flat layers of current-producing elements, making practically a solid block. The layers make connection with each other automatically, and occupy all available space inside the battery case. Layer-building packs more active materials in a given area, and makes those materials produce more electricity.

Every loud-speaker set should use Heavy-Duty batteries, for they alone offer economy on modern receivers. When you buy new "B" batteries, be sure to get the Heavy-Duty size, and remember that the Eveready Layerbilt has proved to be the longest lasting, most economical of all Heavy-Duty batteries.

Our laboratories are continually testing batteries, and in all our tests we have yet to find a battery that is equal to the new improved and radically different Eveready Layerbilt "B" Battery No. 486. The development and perfecting of this remarkable battery is an outstanding battery-building achievement. It is the result of many years' experience plus the facilities and resources of the pioneer manufacturers of all dry cell batteries.

NATIONAL CARBON CO., INC.
New York San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night —9 P. M., Eastern Standard Time, through the following stations:

WEAF–*New York*
WJAR–*Providence*
WEEI–*Boston*
WTAG–*Worcester*
WFI–*Philadelphia*
WGR–*Buffalo*
WCAE–*Pittsburgh*
WSAI–*Cincinnati*
WTAM–*Cleveland*
WWJ–*Detroit*
WGN–*Chicago*
WOC–*Davenport*
WCCO {*Minneapolis* *St. Paul*
KSD–*St. Louis*
WRC–*Washington*
WGY–*Schenectady*

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Popular Radio

EDITED *by* KENDALL BANNING

FOUNDED 1911

VOLUME XI March, 1927 NUMBER 3

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(Cover design by Frank B. Masters)

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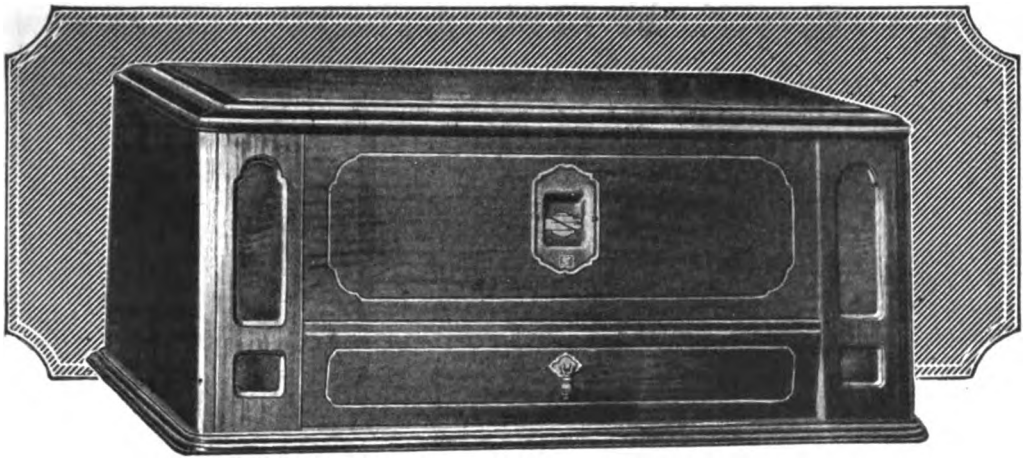

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A Page With The Editor

In the next issue of Popular Radio (for April) will appear an innovation that the editors have reason to believe will prove of exceptional interest and value to all classes of readers—a greatly expanded list of the outstanding broadcast features for the ensuing month.

* *

This forecast of what may be properly considered as "gold star" events (which has been published in condensed form in this magazine for several months) is being carefully compiled with the special assistance of the broadcast stations; the dates, the hours, the stations, and the designations of these features as established by their sponsors will all be listed for ready reference—and will be augmented by personal items about the artists, the program sponsors, the station directors, the announcers, the composers and by other details of outstanding interest.

* *

When the February number of Popular Radio made its appearance on the newsstands with its article "Will Radio Kill the Wild Savageries of Jazz?" by Earl Reeves, we discovered—not greatly to our surprise—that we had stirred up what is euphonistically described as a "hornet's nest."

* *

The effect that the broadcasting of jazz has had and is having upon the sales of sheet music, phonograph records and piano rolls is, apparently, little less than devastating; if broadcasting hasn't killed jazz, it has half killed it—if the reports that reach us are correct.

* *

"Our experience supports the conclusions reached by the author, that the too frequent repetition of music in broadcast renditions operates to decrease and in some cases entirely destroy the sale of sheet music, records, and piano rolls; also that the life of any popular composition, if it is broadcast at all extensively, is shortened at least fifty percent," reports Jerome H. Remick & Company of New York, one of the largest publishers of sheet music.

* *

While from Mr. E. C. Mills, Chairman of the Board of the Music Publishers Protective Association, comes a more comprehensive report. He writes in part:

* *

"Radio broadcasting has had a tremendous effect upon the music publishing business generally. While, on the one hand, it undoubtedly brings to the attention of millions of people with much greater rapidity than was previously possible the merits of any certain work, on the other hand, through the constant broadcasting by hundreds of stations of any work in which the public evinces an interest, the taste and desire for it is so quickly satisfied and satiated that almost before any commercial reward can be reaped by the composer, author and publisher of the composition, the demand for it has faded almost to the vanishing point.

* *

"In 1924 a tremendous interest in radio programs depreciated our general business nearly fifty percent. In 1925 the effect was somewhat less noticeable and during 1926, though the gross sales position has been improved, in order to accomplish this the production of a great many more compositions with the resulting vastly increased overhead has been found necessary."

* *

It was inevitable that the composers and publishers of jazz should seek to obtain at least partial compensation for their losses from the broadcasters. Exaggerated rumors of the fees paid for radio talent—rumors which the ubiquitous press agent perhaps unwisely has made no effort to stop—have created the impression that there is "big money" in broadcasting. And the creators of jazz are at present engaged in an effort to get their fingers in the pie and to extract some plums in the form of royalties.

* *

The subject is of such importance, not only to the composers and publishers but to the broadcasters and to the radio public, and is so fraught with misconceptions, as to justify an unbiased investigation by Popular Radio—beginning with the collection of some authenticated facts. Readers who have such at their disposal are invited to submit them to the Editor of this magazine.

* *

On page 112 of the January issue of this magazine appeared a short item that told of the "first case of vandalism directed against a broadcasting station," when the cable leading to the antenna of WRNY was maliciously cut during the broadcasting of a Jewish religious service.

* *

This item inspired an anonymous reader to postcard in: "This is to inform you that the antenna of WRNY was cut during a Jewish performance by a rabbi'd fan."—Which is *our* idea of a perfectly terrible pun!

* *

The attitude of the Actor's Equity Association in forbidding its members to participate in the performance of a play that is broadcast—even though the broadcasting is picked up direct from the stage during a regular performance before an audience—except upon the payment of a bonus of one-eighth of their weekly salaries, has been subject to criticism not only by the radio fans but by many of the theatrical profession themselves.

* *

Just what effect this broadcasting of one play, "Wildflower," had upon the paid attendance (and few can deny that a large audience benefits not only the producer but the actors as well, is revealed in a statement recently made by the well-known advertising man, William H. Rankin, of New York.

* *

"When we were called in," reports Mr. Rankin, "the play was having a bad slump and box office receipts had fallen off seriously.

* *

"Hector Fuller wrote a twenty-minute talk, selling the play. He gave these talks himself, and immediately afterward the play was broadcast from the stage. At the end of the play the announcer said that anyone who had listened in on the radio and who went to the box office during the next week and bought a ticket would be given an autographed photograph of Edith Day, who was then starring in 'Wildflower.'

* *

"The next day 500 people bought tickets, as the result of the radio publicity. From that time 'Wildflower' played to full houses. Every day people crowded to the box office; many of them had to be told there was a standing room only."

* *

But as we stated in the January issue of Popular Radio, the broadcasting of a play direct from the stage is probably of greater value to the producer and to the actor than to the broadcast listener, and the ban imposed by Equity is more likely to hurt than to help the very people it is designed to benefit.

* *

For the experimenter the coming issue of Popular Radio will contain two contributions of particular and timely interest.

* *

One article will give the complete constructional details of the new Browning-Drake set—contributed by the inventors themselves.

* *

The other article will tell how to build the new SC-II receiver—which is a development of the popular SC receiver described in the March, 1926 number.

Kendall Banning

Editor, Popular Radio

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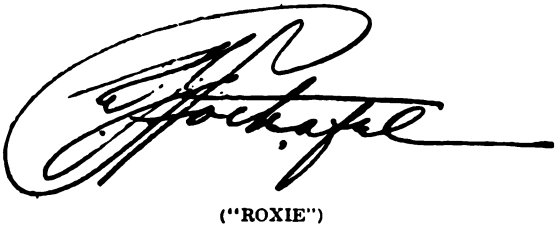
Kadel & Herbert

Interesting in Its Technical Features as Well as in Its Human Appeal

"I would like to write a whole story about POPULAR RADIO. *I will only say, however, that I read it every chance I get and find it most interesting, not only from a technical standpoint but from the human standpoint."*



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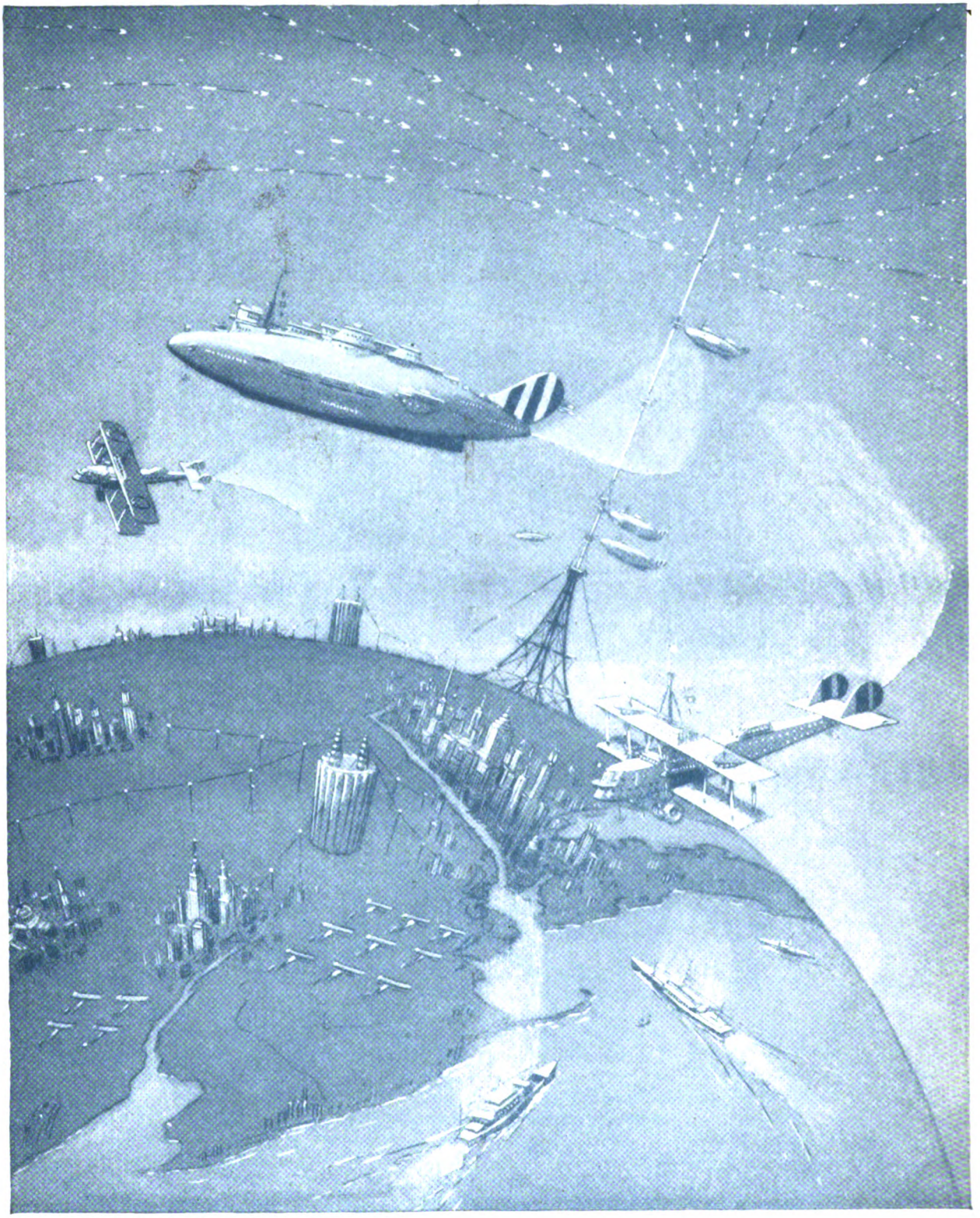

From a drawing by Arthur Merrick for POPULAR RADIO

When the World's Motive Power Is Collected by Antennas

Science may discover a new form of radiant energy and inventors may design machinery that can harness this force and put it to work—to run our factories, to heat and light our homes, and to drive air, sea and land craft at incredible speeds.

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Popular Radio

VOLUME XI March, 1927 NUMBER 3

Radio in 1950 A. D.

Some of the amazing possibilities that are visualized by a world-famous scientist and inventor—

DR. LEE DE FOREST

TO the workaday experimenter in the field of radio, absorbed in the practical problems of the next immediate advance along the path of discovery, imagination is a working tool.

But the imagination of the experimenter soon finds itself beyond the bounds of radio phenomena; it ranges out into the realms of the ether. Radio is but one small step in the exploration of an infinite progression of vibrations which quickly get beyond anything but mathematical calculation.

This earth of ours is literally bathed in radiant energy from interstellar space; it bowls along on its way fairly immersed in seas of cosmic force.

"We have actually succeeded in our lifetimes in finding more new relations in physics than had come to light in all the preceding ages put together, and the stream of discovery as yet shows no sign of abatement," says Dr. R. A. Millikan, who is himself playing an important part in it all.

Let us for a moment speculate upon some of the possibilities and probabilities that lie ahead of us—basing our speculations not upon mere fancy but upon the accomplishments of the past in the new field that radio has opened up.

One of the most important is the possibility that some day we may learn how to draw electricity from the upper air in amounts to suit the individual need of the moment.

Some day it may become possible to build and maintain conductors ten miles high, with a series of antennas to gather in and store up the vast energy that exists in the form of enormous potentials between the upper atmosphere and the surface of the earth. When that time comes we will be able to utilize this exceedingly high potential energy for performing work for mankind. If this power were harnessed, local power stations could be established wherever desirable to supply large zones with electricity and power—and the human race would be immensely wealthier.

When that time comes any one of us—the manufacturer, the railway executive, the newspaper owner, the electrical engineer, the farmer, the housewife—can get power with ease. Questions of warmth, of light, of transportation—age-old problems fundamental to human progress—will cease to exist. Never again will we be bothered by speculations over the time when our reserves of coal and petroleum would be exhausted, as they must, some day.

To speculate further:

We may discover a new radiation which follows the surface of the earth. Or perhaps some other form of radiant energy will be brought to light that can be directed in intense streams as accurately as a man plays a hose. The nozzle of such an imaginary hose located on the Atlantic coast and with its streams of energy directed due west across the United States, may furnish energizing power to airplanes that will thus be made capable of many times the speed now possible; a thousand miles an hour may well be within reach. We may cross the American continent after breakfast and lunch on the Pacific coast—and return in time to dine in New York! Or we may cross to London in 3 hours. Indeed, streams of energy may be played in whatever direction that there will be traffic; we may literally go "rolling down to Rio" between luncheon and dinner!

Mammoth planes may then travel far above the storm belt as we speed across the sky; disturbances of the air would mean no more in that case than international boundaries. And how long will international boundaries be regarded as important when London is practically in New York's front yard and San Francisco out by the garage?

The electrical frequencies used in radio, which have become a commonplace in our lives at present, are about a million times greater in cycles per second than the audible frequencies upon which humanity had depended for communication for thousands and probably hundreds of thousands and possibly millions of years. The speed of light, as is now generally accepted, is about the same as for radio waves, or approximately 186,000 miles a second. Now comes Dr. Millikan with a new ray that is said to have a frequency 10,000,000 times that of the highest light rays—and light waves constitute the fastest phenomena that is percep-

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tible to the human senses! This new ray goes around the earth some 75,000,000 times in a single second!

What is the use of trying to put such a frequency into terms comprehensible to the human mind? And, conversely, why regard anything in natural phenomena as "impossible?"

These "cosmic rays" discharge the electroscope even though it be sheathed in lead, which we know is not possible even with the X-ray. They have a frequency 1,000 times greater than that of the X-ray. When the electroscope is plunged into water with an absorption coefficient equal to the atmosphere above it at that point, these cosmic rays show the infinitely tiny wavelength of .0004 angstrom units.

Only a vivid imagination can gain even a relative conception of this!

But even within the band of the high frequencies used in radio there is ample room for speculation and for development.

The short wave for transmission and reception is receiving a lot of attention and may help us over some difficult places. The transmitting amateur experimenters may properly feel that at last they are coming into deserved recognition. The "short-wave beam" offers a fruitful field to the constructive and experimentally inclined radio enthusiast.

It has long been evident that a dependable means of directing waves from 2 or 3 meters up to 50 meters without fading, bending, or defraction, would be a great advance in radio.

Only a slight amount of power in kilowatts is required to operate on these short wavelengths. They may be sent out at a diffusion angle small enough so that the sender can at least control their direction to a considerable extent; this factor gives a degree of secrecy hitherto unattainable. The more this directional factor is developed, the greater will be the secrecy that can be obtained.

We probably will hear much of overcoming atmosphere troubles and disturbances by means of the short wave. We have been seeking a solution of static—or "atmospherics," as the Englishman calls it—at the receiver for the past twenty-five years. Progress along this line is steady, if it does seem rather slow.

By using the photo-electric cell and boosting its sensitiveness many thousand times with the audion tube, we can now transmit pictures and writing by radio.

Transmitting pictures, however, is not true television.

When we can sit in a darkened theatre or in our home, in New York, and watch on the screen the movement of the holiday crowds in Chicago, or when Chicagoans can see a New York theatrical performance on the screen; when we can see the seals disporting themselves on the rocks off Golden Gate Park in San Francisco; when the film magnate in Manhattan can actually oversee the work of his directors on "the lot" at Hollywood, or a congregation in an American church with its own eyes can view the Pope celebrating mass in the Vatican—when any of these experiences actually come to pass, then we shall have true television.

Mechanical difficulties in the way are great, but the necessary "speeding up" processes are being studied and slowly evolved in scientific laboratories. Physically, television—the ability to see over long distances—is perfectly possible, but the transmission and reception details are complicated and need further working out.

Some Day We May Be Able—

To eliminate static;

To "see by radio," to attain true television;

To run the clocks of the world by radio impulses;

To draw electricity from the atmosphere and to put this power to work for man;

To direct streams of radiant energy that will drive airplanes at tremendous speed.

It is easy to let imagination rove—and whatever we imagine may come to pass almost before we are aware of it. I am ready to agree that television may sometime come—and what a marvelous stride ahead civilization will take when it does!

What may soon be done in the regulation of watches and clocks by radio seems of more immediate interest.

It is possible, even at this date, to use a simple receiving set for this with a relay which corrects itself once or twice a day, or to adjust the escapement in watch or clock so that it will register an impulse from a master station every second or two. This is actually little more than the Western Union Telegraph Company is doing now with myriad clocks which are electrically operated and regulated. An impulse is sent by wire every ten seconds. In the case of our watches we should doubtless have to arrange to pull these from the pocket at a prearranged moment—say on the hour or half hour, or oftener—and hold them steady in a certain position.

There is no reason why the desk clock in one's office should not be thus kept accurately on the second with Greenwich time.

Meantime some of the most vital advances in radio will come in developments of broadcasting. One day soon the ordinary audion (or vacuum tube valve) may be used to extend the hearing power of the human ear around the globe—to enable us to listen to audible sounds anywhere else.

Think, for instance, of listening in on a tiger hunt in India, or on an elephant hunt in Africa—or on a Henley regatta in England! Or of hearing the balls click on the gaming tables at Monte Carlo, or the sounds of war and all that goes with it!

Broadcasting is already becoming highly specialized and will become more so. We may now listen in on Congress or State legislatures in their sessions; we are beginning to be taken into the homes, the clubs and the offices of public men and women.

It will be hard on the politicians when their constituents generally have this check on what they do and say, but it will make for a realization of pure democracy such as no nation has ever had.

One pleasure we have now in some measure we shall ere long have much more of—the radio drama.

Instead of listening in on bits from plays, striking scenes or even a whole act, why not both hear and see the whole play by radio? Or sporting events?

I believe, also that radio is destined to play a big and significant role in our scheme of education.

Even now the radio set is no uncommon thing in schoolrooms, but real radio schools are coming—a system of education in which much of the instruction will be given radio, with a curriculum specially arranged with that end in view. That will mean more than schoolrooms where receiving sets are installed; it will mean that students can then receive such educational advantages in their own home towns or even in their homes, as no single college or university can give them now.

Radio is developing its own technic and, instead of being an afterthought, will be a leading thought in the preparation for any event where the medium of expression is vocal or instrumental.

(*Continued on page 279*)

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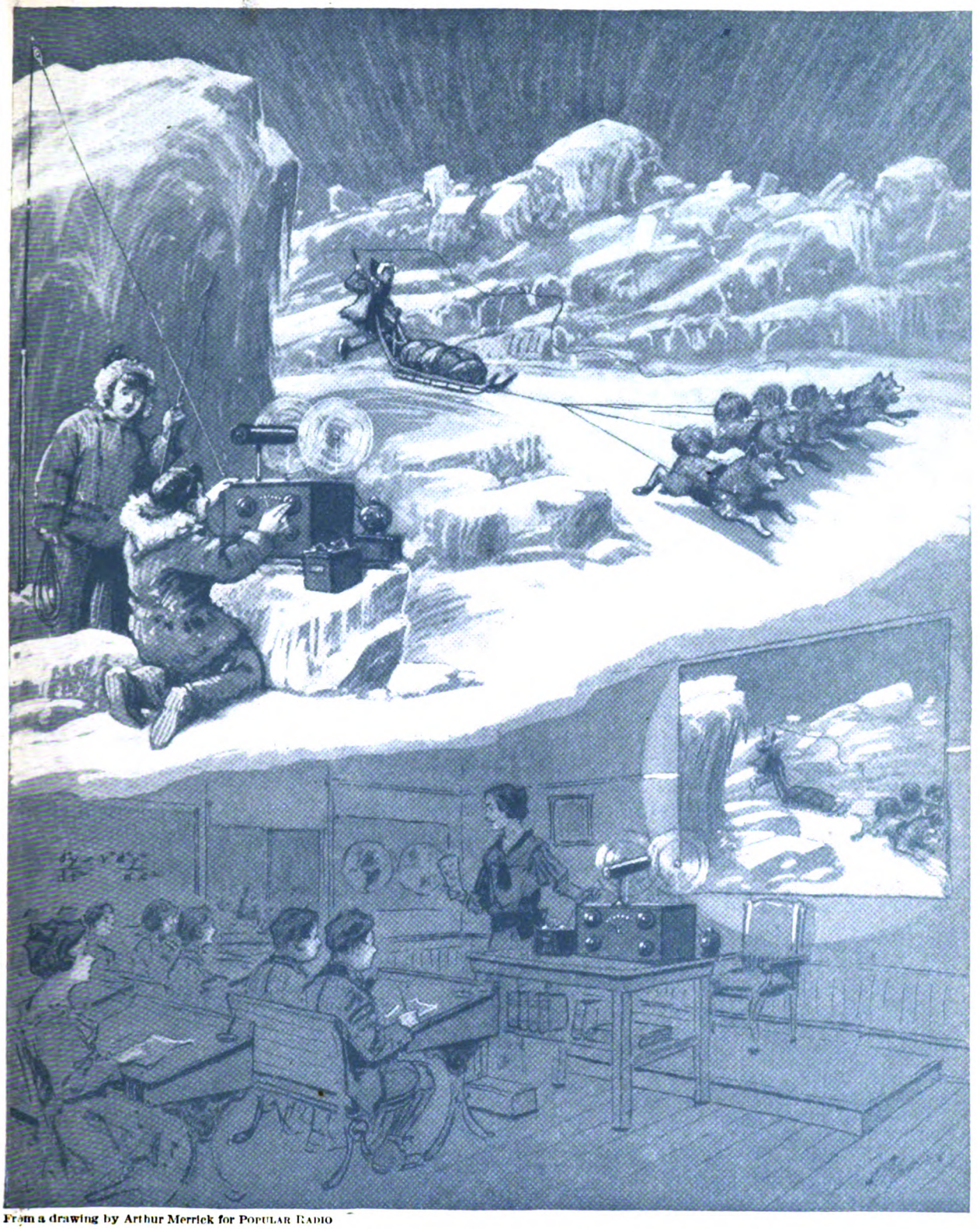

From a drawing by Arthur Merrick for POPULAR RADIO

When Radio Permits Us to Look In as Well as to Listen In on the Rest of the World

The time is approaching when receiving sets will be regarded as a regular part of the physical equipment of our schools and universities; many of us may yet see television apparatus similarly installed for "looking in" not only upon class-room demonstrations but also upon explorations in foreign lands, legislative bodies in session and world-events of interest.

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From a photograph made for POPULAR RADIO

TESTING THE FINAL MODEL OF THE RECEIVER

This picture shows how the completed laboratory model of the receiver looked during the final test on its operating characteristics. In the foreground may be seen the multivalve; this tube has made possible the remarkable results obtained with this receiver.

HOW TO BUILD

The Univalve Receiver

Here, at last, is a stable one-tube receiver that will operate a loud-speaker satisfactorily on local stations without the use of crystal detectors or microphone amplifiers. The circuit was developed to utilize the new multi-valve—a single tube that does the work that has heretofore needed several tubes.

By A. J. HAYNES and LAURENCE M. COCKADAY

COST OF PARTS: *Not more than $40.50*

HERE ARE THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS RECEIVER—

A and B—Hammarlund autocouplers;
C and D—Cardwell SLF variable condensers, .00035 mfd., equipped with Cornell etched vernier dials;
E—Karas Harmonik low-frequency transformer;
F—Thordarson low-frequency transformer 2 to 1 ratio;
G—any approved battery switch (Carter switch illustrated);
H—any approved automatic filament control, .25 amp. (amperite No. 1A illustrated);
I—any approved mica fixed condenser with grid-leak clips, .00025 mfd., (Electrad condenser illustrated);
J—any approved mica fixed condenser, .0001 mfd. (Electrad condenser illustrated);
K—any approved mica fixed condenser, .0005 mfd., (Electrad condenser illustrated);
L—any approved grid-leak, 4 megohms (Polymet grid-leak illustrated);
M—any approved small single-circuit jack (Electrad jack illustrated);
N—bakelite front panel, 7 by 15 by 3/16-inch;
O—hardwood sub-base, 7 by 14 by ½-inch;
P—bakelite binding-post strip, 1 by 9 by 3/16-inch;
Q1, Q2, Q3, Q4, Q5, Q6 and Q7—any approved binding posts, marked Ant., Grnd., A Minus, A Plus, B Minus, B Amp. Plus, B Amp. Plus, respectively (Eby binding posts illustrated);
R1 and R2—small brass brackets;
S—Benjamin vibrationless socket.

¶ *The list of parts given above includes the exact instruments used in the set from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

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HERE is a new set that employs only a single vacuum valve (or tube) with which local reception at full loudspeaker strength is possible!

This is accomplished by the use of the new Multi-valve, a vacuum valve that takes the place of all the tubes in an ordinary set.

The design of the receiver incorporates one stage of high-frequency amplification, a detector and two stages of low-frequency amplification.

No crystal is used in the set; all of the amplification and detection is done by by means of the single valve.

The circuit used is a new development, incorporating the little-known but highly efficient shunt reflex that eliminates all of the howls and squeaks that accompany the more common form of reflex circuits.

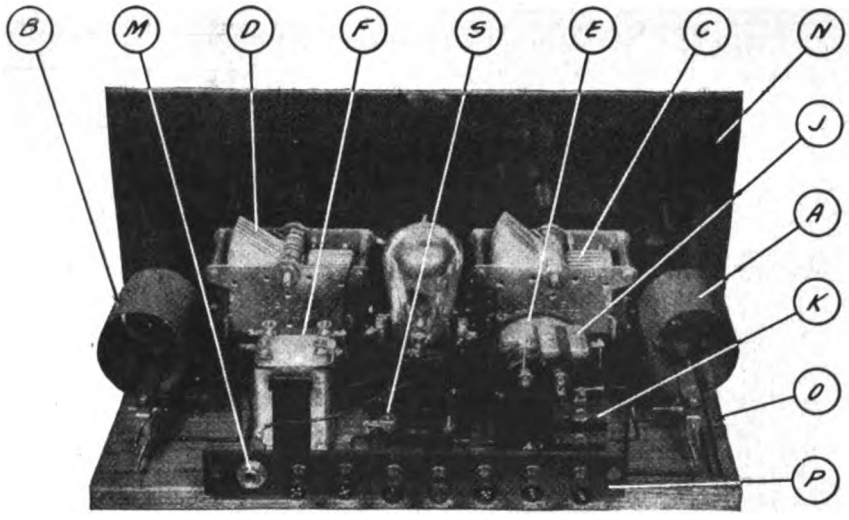
The apparatus chosen for use in this set was carefully picked with the proper electrical constants, so that the maximum volume and the best tone quality of which this system is capable might be obtained.

In initial tests on this receiver, listeners, who were invited to hear it, were both mystified and surprised at its performance, for while an ordinary one-tube receiver furnishes only enough volume to operate headphones, this set gives good loudspeaker volume.

The wiring diagram for the receiver is shown in Figure 4.

How to Construct the Set

When all of the instruments and materials for building the set, as listed at the head of the article, have been procured, the front panel, N, should be prepared.



A VIEW OF THE SET FROM THE REAR

FIGURE 1: *This view shows the general arrangement of the instruments that are mounted on the wooden sub-base and on the panel itself; notice that the loudspeaker jack is connected to the binding-post strip in the rear.*

First, cut the front panel, N, to the correct size, 7 by 15 inches. Then square up the edges smoothly with a file. The centers for boring the holes by means of which the instruments are mounted should then be laid out on the panel, as shown in Figure 6. A convenient method is to lay out all center holes on a piece of paper the same size as the panel; then the piece of paper may be fastened on the panel and the centers marked directly on the panel by punching through the paper with a sharp, pointed instrument.

If all the holes to be drilled are first started with a small drill, one-sixteenth of an inch in diameter or less, they can be more nearly centered.

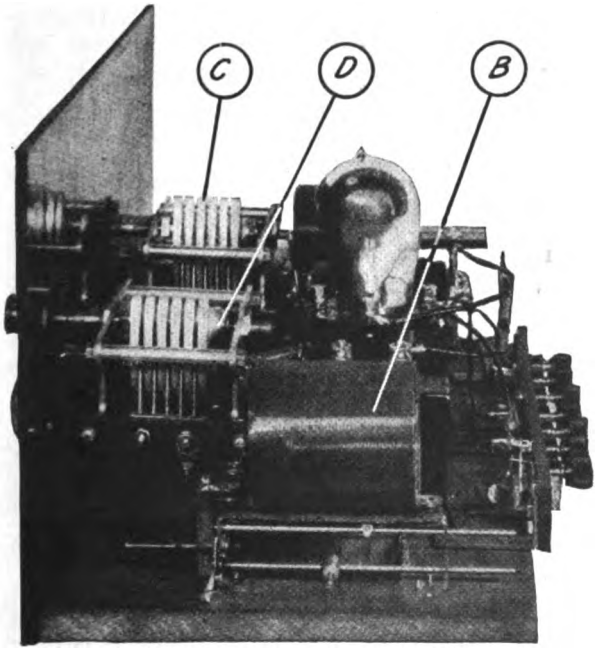
After the panel, N, has been prepared, the two condensers, C and D, should be mounted on it by means of the flat-head machine screws that come with the condensers. Figures 1 and 3 show the position occupied by these two condensers and by the switch, G, which is mounted at the lower part of the panel, N, between the two condensers, C and D.

Next, attach the two vernier dials to the condenser shafts and the construction work on the panel is completed.

The next job will be to cut the hardwood baseboard, O, to the proper size, as given in Figure 5, and to mount coils A and B. These are fastened to the baseboard, O, by drilling two holes directly through the baseboard and by countersinking the bottom side of the holes, so that screws may be inserted through and fastened into the brass legs that are used to mount the coils. Be sure that the holes are countersunk deep enough, so that the heads of the screws will not project beyond the under surface of the baseboard.

Next, mount the vacuum-valve socket, S, by means of two screws and mount transformer E and transformer F. The other instrument to be mounted directly on the baseboard is the automatic filament control, H, which is mounted by a single screw. The condensers, I, J and K, and the grid leak, L, are supported by the wiring; this job may be left until later.

Next, prepare the binding-post strip, P, as shown in Figure 7 and mount the seven binding posts, Q1 to Q7 inclusive, in their proper positions, as



AN END VIEW OF THE RECEIVER

FIGURE 2: *The method of mounting the coils, condensers and the binding-post strip are shown here as seen from the left end of the Univalve-receiver; note the flexible connections to the valves.*

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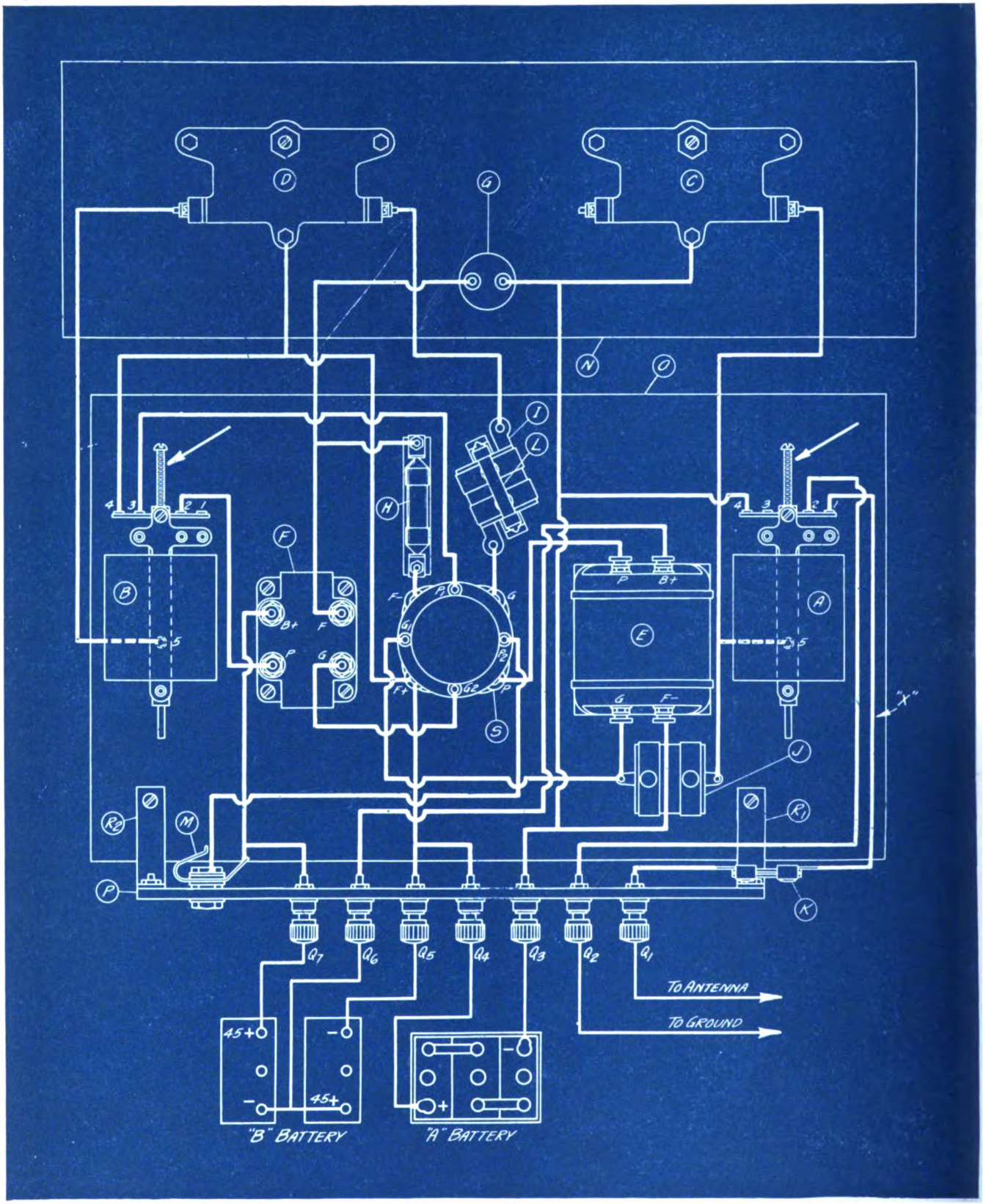

THE PICTURE WIRING DIAGRAM

FIGURE 3: *The instruments, in the above diagram, are drawn in about their relative positions on the baseboard, panel and binding-post strip. The heavy white lines show exactly where to run the wires in wiring up the receiver; the dotted lines running to terminal 5 on coils A and B merely indicate the wire runs underneath the coil. The connections that run to terminals G1, P1, G2 and P2 of the multivalve should be made with flexible wire. At the bottom of the diagram will be found the connections for the "A" and "B" batteries as well as for the antenna and ground. All of the parts in the diagram are designated by the same letters that appear in the text and other diagrams and in the list of parts at the head of the article. No trouble should be experienced in wiring the set if this diagram is carefully followed.*

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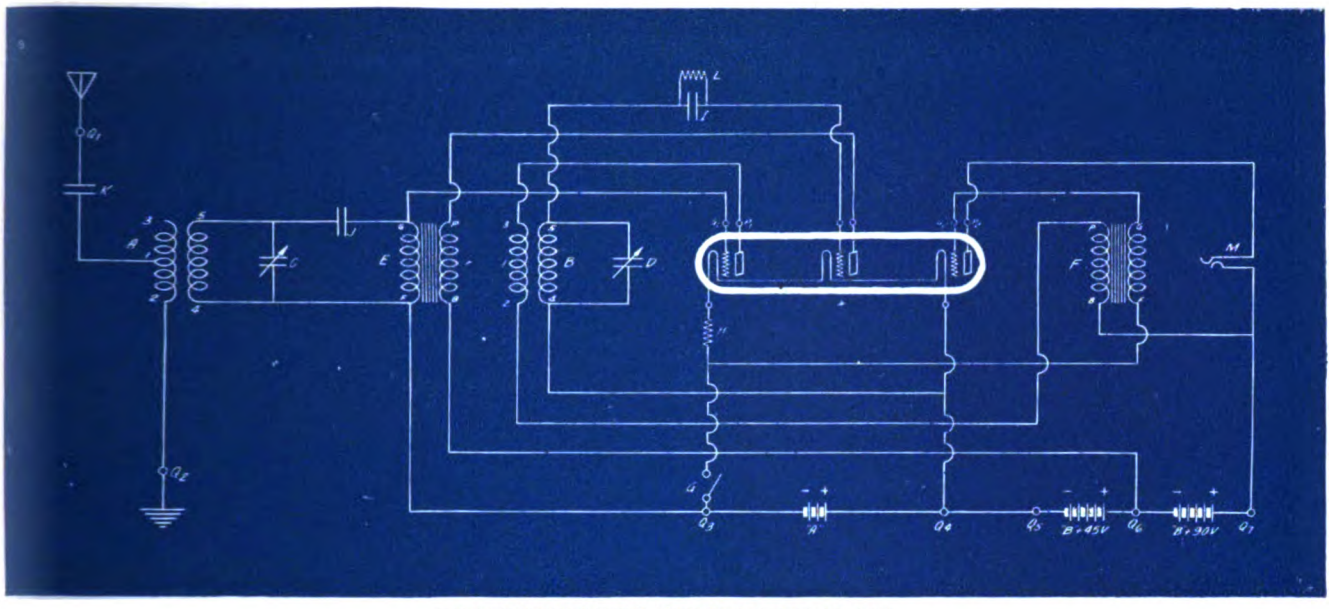
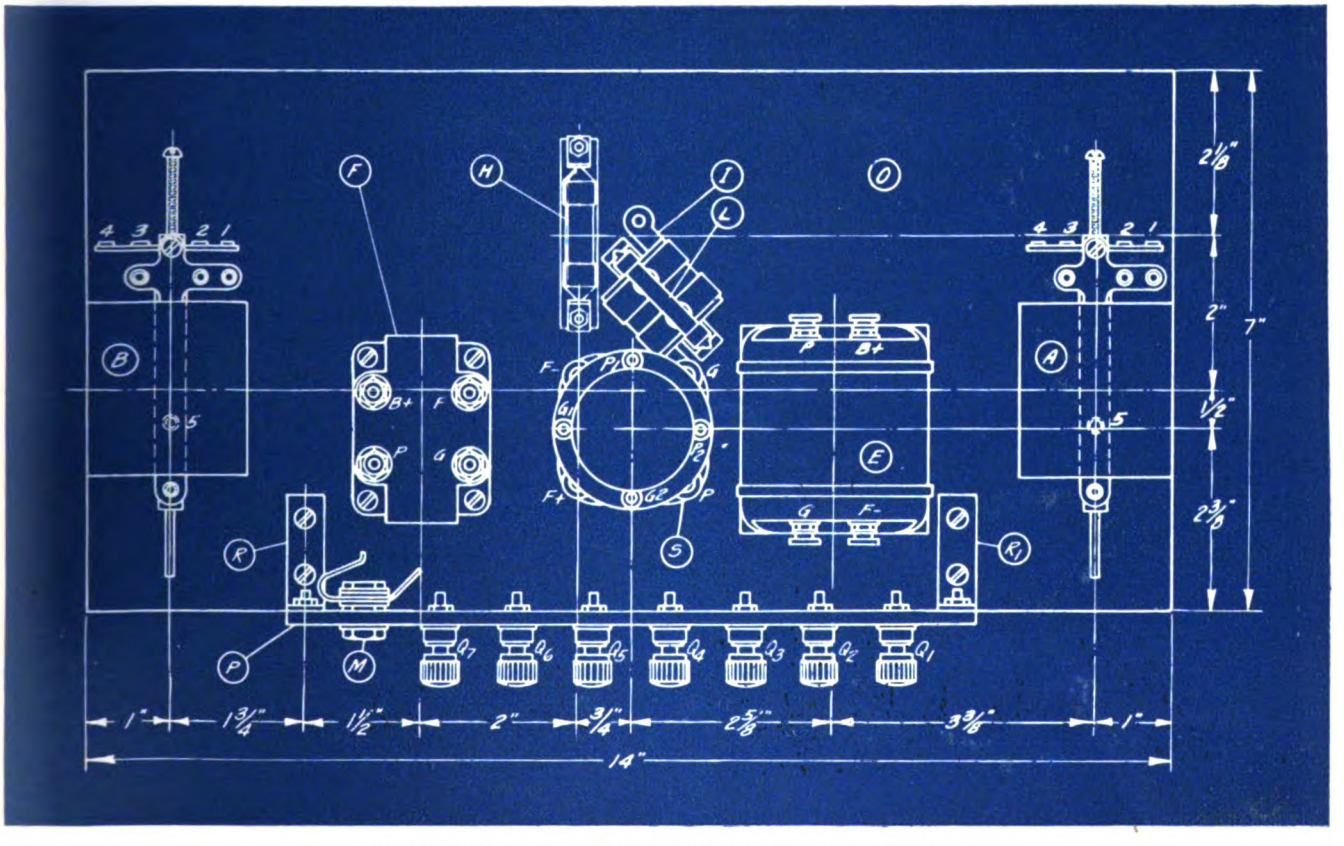


THE SCHEMATIC CIRCUIT DIAGRAM

FIGURE 4: *In this drawing the three sets of elements within the tube are clearly shown together with the proper connections. The first set of elements on the left are for the high-frequency amplifier; the elements on the extreme right are for the last stage of low-frequency amplification. The middle set of elements are used as a detector.*

¶ *For the benefit of the experimental set builder who may prefer to assemble the Univalve Receiver from larger diagrams than can be reproduced within the limited space of these magazine pages, a set of simplified blue prints in actual size have been prepared. This set includes (1) the working drawing for construction, (2) the panel layout, and (3) the picture wiring diagram, in addition to (4) the schematic circuit diagram and the complete list of parts used in the laboratory model. If this set of blue prints cannot be obtained from your dealer, it will be furnished upon receipt of a remittance of $1.00 sent to the* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City.*



THE WORKING DIAGRAM FOR CONSTRUCTION

FIGURE 5: *The exact size of the sub-base with the exact spacing for the coils, transformers and other instruments are given here. The arrangement of the connection block on the sub-base is also indicated.*

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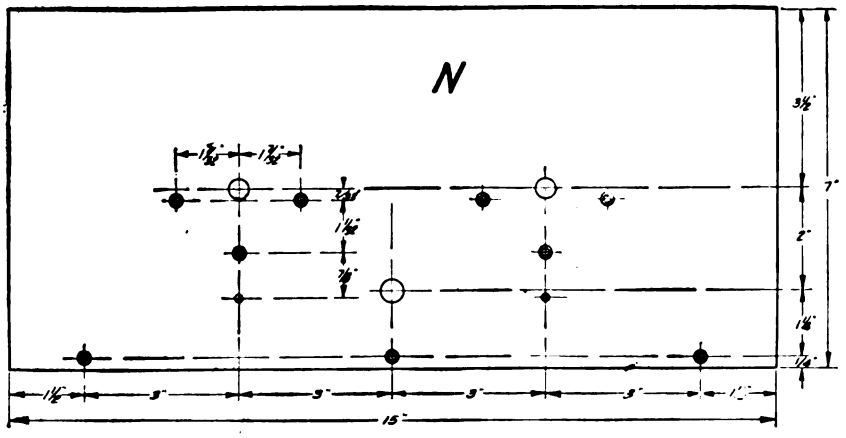


HOW TO DRILL THE PANEL

FIGURE 6: *The exact positions for the holes that are used to mount the instruments are given in this drawing. The sizes for the holes should be determined by examining and measuring the instrument shafts or the screws that are to fit in the holes.*

shown in Figure 5. Also fasten on the strip the jack, M.

Then mount the binding-post strip, P, on the wooden baseboard, O, by means of the two small brass brackets, R1 and R2.

The constructional work is now completed and the set is ready to be wired.

How to Wire the Set

The design of this set is such that the wiring of the grid circuits and other critical wiring that carries high potential currents, is made extremely short and is isolated from other parts of the circuit. In fact, this idea has been employed throughout and the leads are so arranged that the shortest connections may be used. The set should therefore be wired with bus-bar.

Either a tinned-copper bus bar or an insulated bus wire such as "Celatsite" may be used for the connections. All connections should first be shaped so that they will fit; they should then be soldered in place.

The wiring that goes to the four upper terminals of the multi-valve should be done with flexible "Celatsite" wire.

Start the wiring on the baseboard, O, by referring to the picture wiring diagram in Figure 3, putting in place all wires except the four leads that go to the two variable condensers, C and D, and the two leads that go to the switch, G.

When you are ready to connect the leads to the four upper terminals of the multi-valve, cut them to approximately the right length and solder lugs to the ends that go to the valve, so that these may be inserted under the binding posts of the valve when the set is ready for actual installation.

Next, attach the front panel, N, to the baseboard, O, by means of three flat-head screws inserted through the three holes already drilled in the panel, into the edge of the baseboard.

Then, wire up the four leads to the variable condenser, C and D, and the two leads to the switch, G.

This completes the wiring and the set is ready for installation.

How to Install the Set

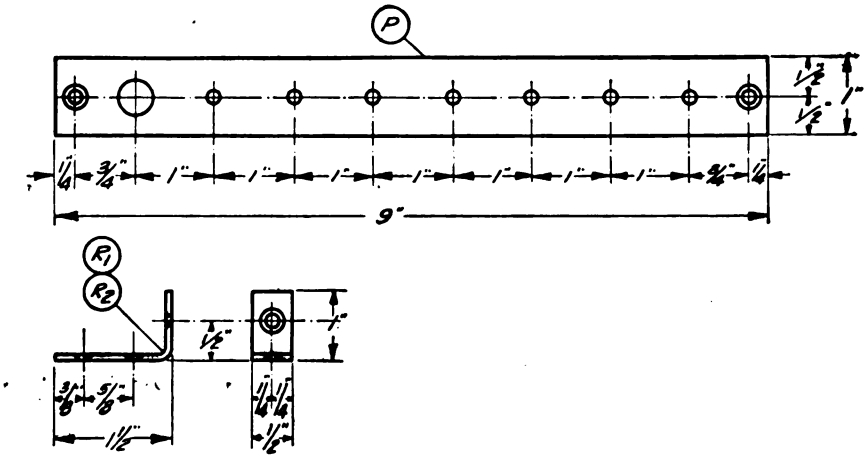
Insert the receiver in a standard cabinet for this size of panel and connect up the batteries to the binding posts, as shown in Figure 3. Next insert the multivalve and attach the leads to the extension terminals G1, P1, G2 and P2. The antenna and ground should also be attached to the proper binding posts on the receiver. The set will work with almost any type of antenna.

Next, attach the cone reproducer by means of a plug into the jack, M, on the binding-post strip, P, and the receiver is ready to function, provided the vacuum valve is in position and properly connected. The reproducer that was found most successful with this receiver was the Rola cone; the characteristics of this cone seem to suit this form of amplification best. In tuning in the receiver, the switch, G, should be set on the "on" position, which lights the filament of the valve; then the two dials connected to condensers C and D, should be rotated so that the stations are brought in. The volume is controlled by setting the first dial, C, slightly off resonance in cases of very loud local stations. The condensers are of the straight-line-frequency type so that the dials will read near 100 at high frequencies and near zero on a low frequency.

The coils, A and B, are equipped with a small screw that varies the coupling. These screws are designated with arrows in Figure 3. By revolving them, the primary coils may be brought out at a distance from the secondary or close to the secondary coil. These coils should be set according to local conditions where the set is to be used. When they are set "way out," the receiver will be very selective, but when they are set "close up," the receiver will tune more broadly and the volume will be increased.

If the set is to be used at a distance of say ten or fifteen miles from the local stations, they should be set close up. Also the lead marked "X," in Figure 3 should be connected to terminal No. 3 instead of to terminal No. 1, if the signals from the stations are not loud enough when the set is more than fifteen miles from the station.

The condenser, K, is used in series with the antenna to add to the selectivity; but in tuning in at greater distances than actual local reception, this condenser may be short circuited; this, again, will increase the range. These adjustments of the coils and the variation of the wire "X," from one terminal to another need only be made once when the set is installed. For ordinary local conditions the connections given in Figure 3 will be found satisfactory in most cases.



HOW TO MAKE THE SMALL PARTS

FIGURE 7: *These drawings give the dimensions for the bakelite binding-post strip and for the brackets that are used to fasten it to the baseboard.*

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Courtesy New York Electrical Society

A SCIENTIFIC THIRD DEGREE THAT USES ELECTRICAL APPARATUS

In conducting an investigation by this new method the examiner is seated at the end of the table, facing the reader; the "criminal" is at his left. The others are assistants operating the electric devices which record the outcome of the tests. Radio devices, says Mr. Elway, might have been used instead in making the various measurements.

THE COMING REFORMATION OF "THIRD DEGREE" METHODS BY

The "RADIO DETECTIVE"

Experiments with highly-sensitive electrical apparatus reveal the consciousness of guilt to the inquisitors of the police department.

By THOMAS ELWAY

THE famous "third degree," still sometimes administered to criminals by unscrupulous detectives well armed with clubs and brass knuckles, is rapidly vanishing from American criminal procedure. Too many citizens believe that even criminals deserve treatment as humane as that which we demand for animals.

To replace the old-time brutal methods of eliciting confessions, science is offering what has been nicknamed the "psychological third degree." Tests devised by modern psychologists and designed to trap the suspect into unwary or unconscious admissions of guilt, are applied to everyone under examination, even to witnesses not suspected of actual complicity. Electric apparatus is used largely in these new tests.

At a recent meeting of the New York Electrical Society, a Society famous in that metropolis for the novelty and popular interest of its programs, Dr. A. P. Link, of the department of psychology at Washington Square College of New York University, described and demonstrated some of the new electro-psychological methods for science's painless variety of the third degree.

The high point of Dr. Link's demonstration was the commission and detection of what he called a "sample crime." Three persons selected from the audience were sent from the room with sealed instructions. After leaving the room these persons determined by lot which one of them was to be the "criminal." The unfortunate holder of the evil lot then opened his instructions, which told him to proceed to another room in the building and commit a "robbery." To add interest and verisimilitude, the instructions informed the amateur robber that if, on his return to the auditorium, he could conceal from Dr. Link the fact that he was the one among the three who possessed a sense of guilt, the sum of money involved would then remain his own. It was real money. An incentive was thus

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provided for success in concealing the guilty knowledge.

The crime successfully completed, all three suspected persons returned to the auditorium together. Neither Dr. Link nor the audience knew which one of the three was guilty. Psychological tests were applied, most of them electrical in nature. By means of ingenious devices constructed especially for the occasion, the results of these tests were made visible or audible not only to Dr. Link and his assistants, but to the audience as a whole. As was expected, and as the psychologists insist will always happen, the guilty knowledge of the one person who was really the robber became immediately apparent, so much so that the audience voted overwhelmingly to select this person as the criminal.

In an actual criminal case it would have been necessary, Dr. Link explained, to conduct much more thorough and comprehensive tests than were possible in the brief time available at a demonstration meeting. Also, it would be unwise to depend upon the mere impression of the observers or upon a vote of the audience. Detailed quantitative data, carefully accumulated and submitted to mathematical analysis, are necessary for any important decision. Even under these circumstances, Dr. Link did not urge the tests as absolutely final or as conclusive legal evidence. What these tests can do, however, is to assist in the uncovering of facts which someone is endeavoring to conceal. A knowledge of these by the officers of the law may assist the solution of many criminal mysteries.

Dr. Link made use of radio methods only in connection with the demonstration of his tests to the audience, not in the tests themselves. One of the things tested is the heart-beat of the subject. It is well known to physiologists that excitement of any kind will increase the rate of the heart-beat. If a heart-beat recorder is attached to the subject while questions are being asked, any especial excitement aroused by a question touching on guilty knowledge is apt to be indicated by a sudden quickening of the heart-beat.

At the Society's meeting the heart-beats of the three suspected criminals were made audible to the entire audience by what is essentially radio equipment, the electrical stethoscope perfected by the Bell Telephone Laboratories and already described in the columns of POPULAR RADIO.

Another of the testing methods used in the psychological third degree is the so-called "association test." In this test a list of words is read, word by word, to the person under examination. He is instructed to respond, as quickly as possible, with some other word which the first word suggests. For Dr. Link's demonstration this test also was given a radio assistant. In front of the suspected criminal under examination was a microphone. Connected with this were the amplifiers and loud-speaking telephones of a public address system. Thus the entire audience, not merely the examining psychologists, heard even the tiniest whisper with which the "criminals" replied to questions or to association words.

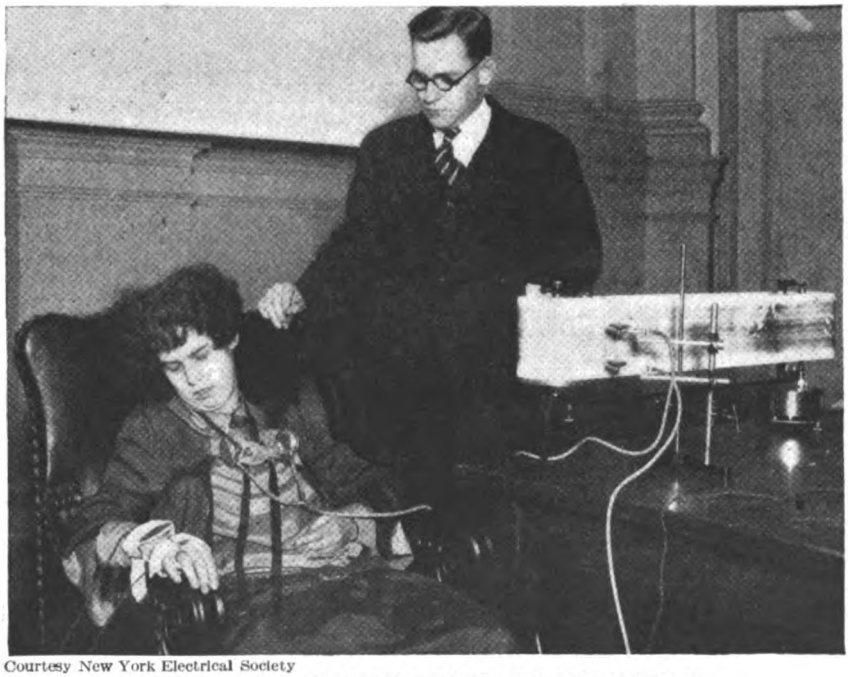
This use of microphones and amplifiers and of the electrical stethoscope, while probably unique insofar as the demonstration of such matters is concerned, was not really an application of radio to the psychological third degree, but merely an application to the demonstration of this procedure to an audience. But is it not possible to go farther? Does not radio have something much more important to offer to the electrical and psychological experts who are now so active in developing these tests?

One of the important practical difficulties with the psychological third degree as demonstrated by Dr. Link is the fact that it requires the knowledge and cooperation of the subject. If a suspected person refuses to submit to the psychological tests most courts will support him in this refusal. Furthermore, it is possible for a person having advance warning of the nature of the tests to control, in some degree at least, the responses which his body makes. There exist, for example, individuals who are able at will to quicken or to retard the beating of their hearts. It is a great need of criminalogic practice to find some method by which the electro-psychological tests may be applied to witnesses or suspects absolutely without the knowledge of the person being tested.

Suppose, for example, that you could have in the office of the District Attorney an ordinary-looking office chair. A person whom the officers wish to question is received pleasantly and is ushered to a seat in this comfortable piece of furniture. Questions are asked and answers given, as they might be in any casual conversation in a business office. There is no appearance that anything special is going on or that any psychological tests are being given. The victim, seated comfortably in his treacherous chair, is the last person to suspect that he is being subjected, invisibly and unconsciously, to a scientific third degree.

Can anything of this kind actually be accomplished? We cannot be sure. Nothing of the sort has been done. So far as I know it has never been tried. Certainly the exact tests used by Dr. Link before the New York Electrical Society cannot be so applied, for these tests require the seating of the witness in the midst of a veritable forest of electrical and other apparatus. It is necessary, even, to attach to the witness's chest the recorder for the heart-beat and to his arm the electrodes for

(Continued on page 284)



Courtesy New York Electrical Society

WHERE RADIO MIGHT REPLACE HYPNOTISM

Variations in the heart-beat of the hypnotized subject are being tested by the apparatus on her chest, connecting with the recorder at the right. A radio recorder similar to those used for making code reception graphs in commercial radio telegraph stations would probably be simpler than the apparatus used here.

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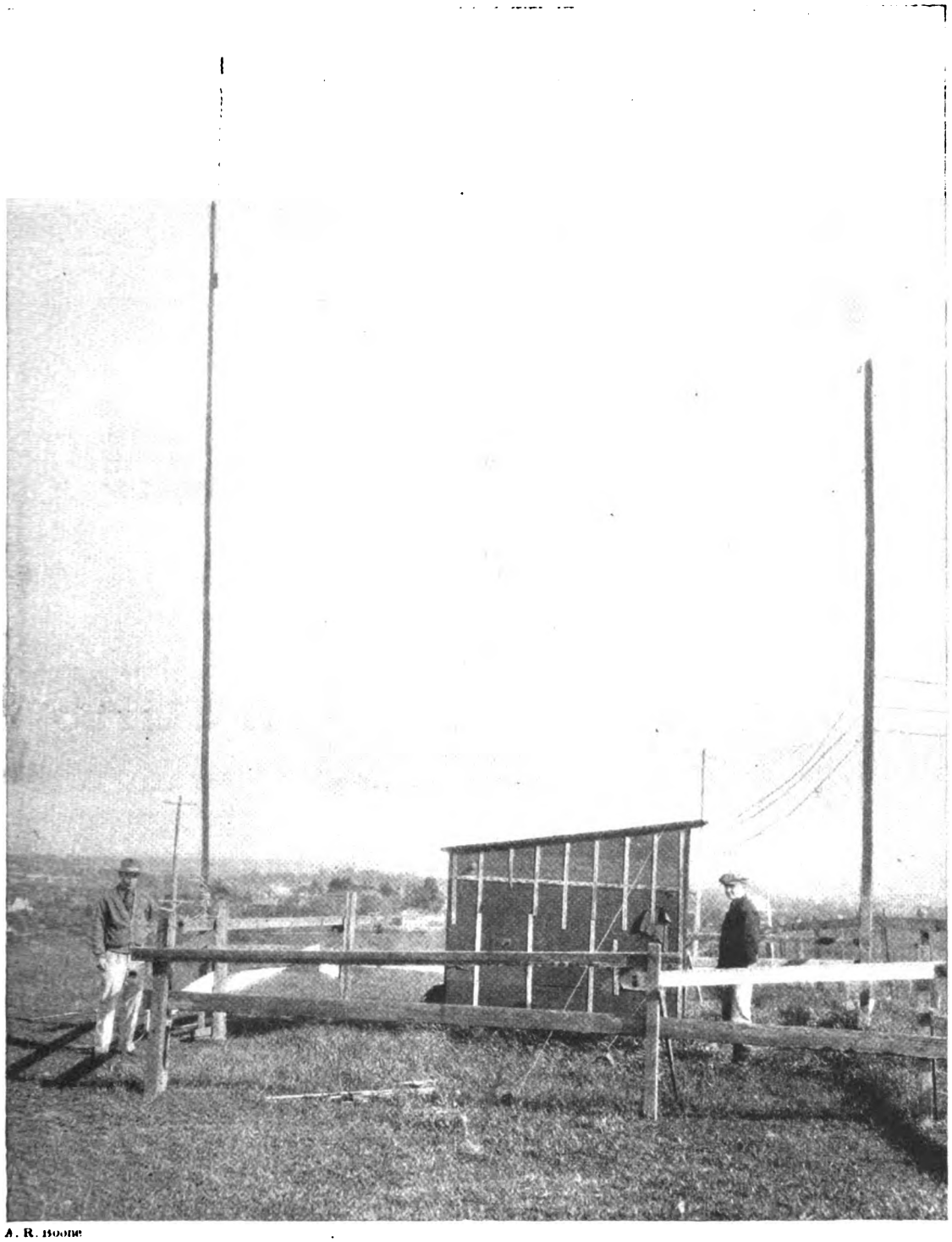

A. R. Boone

The Starting Point for the Radio Waves That Were "Heard Round the World"

From this flimsy shack overlooking San Francisco Bay and with a home-made transmitter Brandon Wentworth (U-6OI), a nineteen-year old college student, has sent out signals that have been picked up in nearly every civilized country on the globe from South Africa and the British Isles to Australia and the Philippines. He transmits on the 20 and 40 meter bands using a 50-watt tube in a three-coil Meissner circuit of the tuned plate, tuned grid, low-loss type on a normal input of 200 watts The mast at the left supports his vertical, 30-foot, transmitting antenna; the one at the right, a 100-foot receiving aerial.

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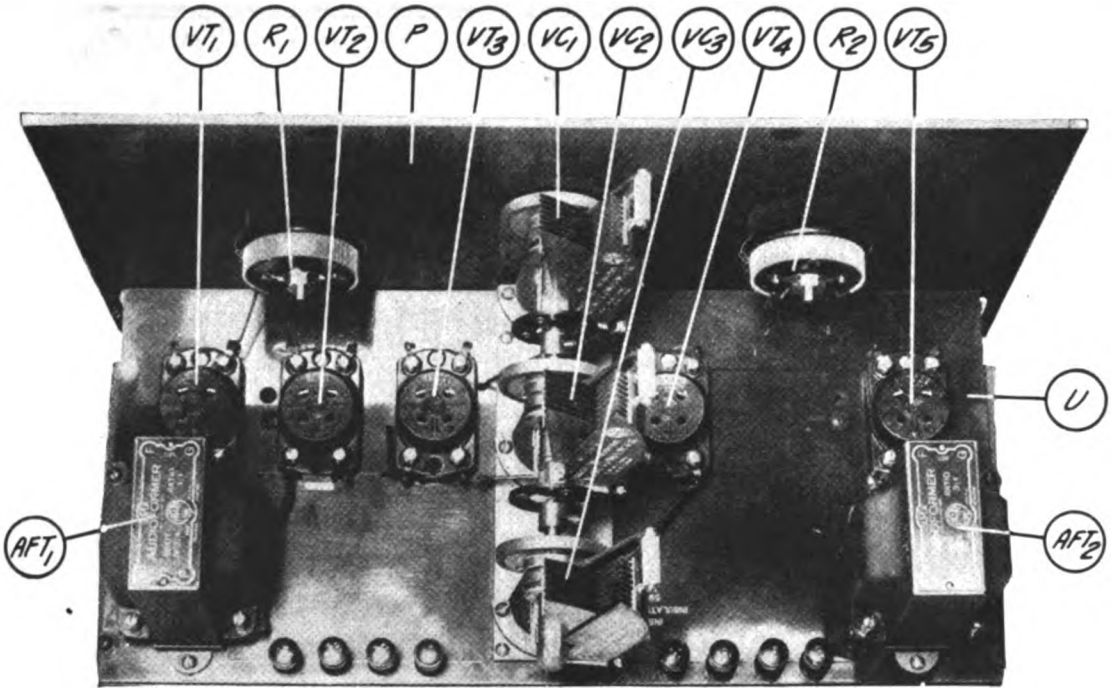


The New "Ultimax" Receiver

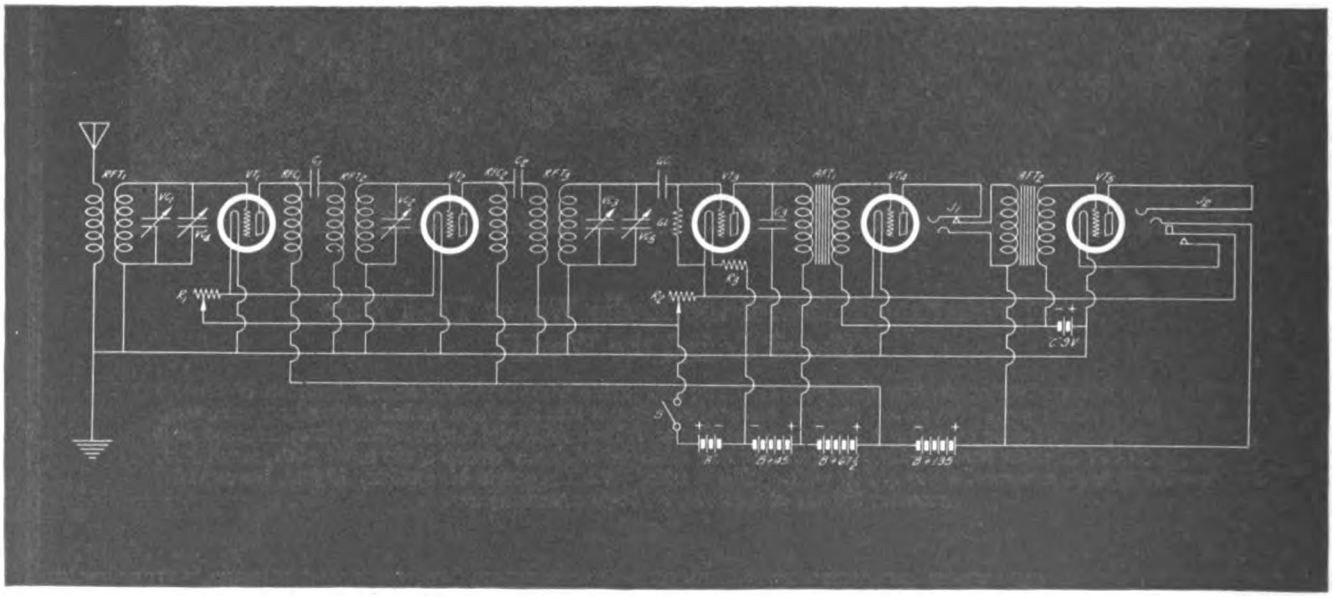
This receiver consists of two stages of high-frequency amplification, a non-regenerative detector and two stages of low-frequency amplification. The unique feature of this circuit lies in a novel coupling arrangement that maintains the amplification at its highest efficiency. Both of these stages, including the antenna coil, are controlled by a single knob. Suitable jacks are provided to conveniently take the output from either four or five tubes.

Popular Radio Circuits

INSTALLMENT NO. 8

THE PARTS THAT ARE RECOMMENDED FOR USE IN THIS RECEIVER ARE—

RFT1, RFT2 and RFT3—Ultimax coil set;
RFC1, RFC2, C1 and C2—Ultimax unit;
C3—Dubilier Micadon fixed condenser, .002 mfd., No. 601;
VC1, VC2 and VC3—Pacent triple-gang straight - line - frequency condenser, No. 3251;
VC4 and VC5—Hammarlund Jr. midget condensers, No. MC5, .000016 mfd.;
AFT1 and AFT2—Pacent Superaudio-formers, No. 27-A;
VT1, VT2, VT3, VT4 and VT5—Pacent "Universal" cushion sockets, No. 83;
R1—Pacent rheostat, 6 ohms, No. 95-A;
R2—Pacent rheostat, 10 ohms, No. 95-B;
R3—Yaxley resistance unit, 4 ohms, No. 804;
GC—Dubilier Micadon fixed condenser; .00025 mfd., No. 601;
GL—Electrad metallic resistor, 2 meg.;
J1—Pacent single-circuit jack, No. 62;
J2—Pacent double-circuit jack, No. 65;
P—Insuline panel, friezed, 8½ by 16 by 3/16 inches;
U—Insuline, sub-panel, 15 by 7 by 3/16 inches;
S—Pacent battery switch, No. 16;
2 Benjamin sub-panel brackets;
1 Kurz Kasch vernier dial No. 591;
8 Eby binding posts;
1 Grid-leak mounting.
COST OF PARTS: $65.00.



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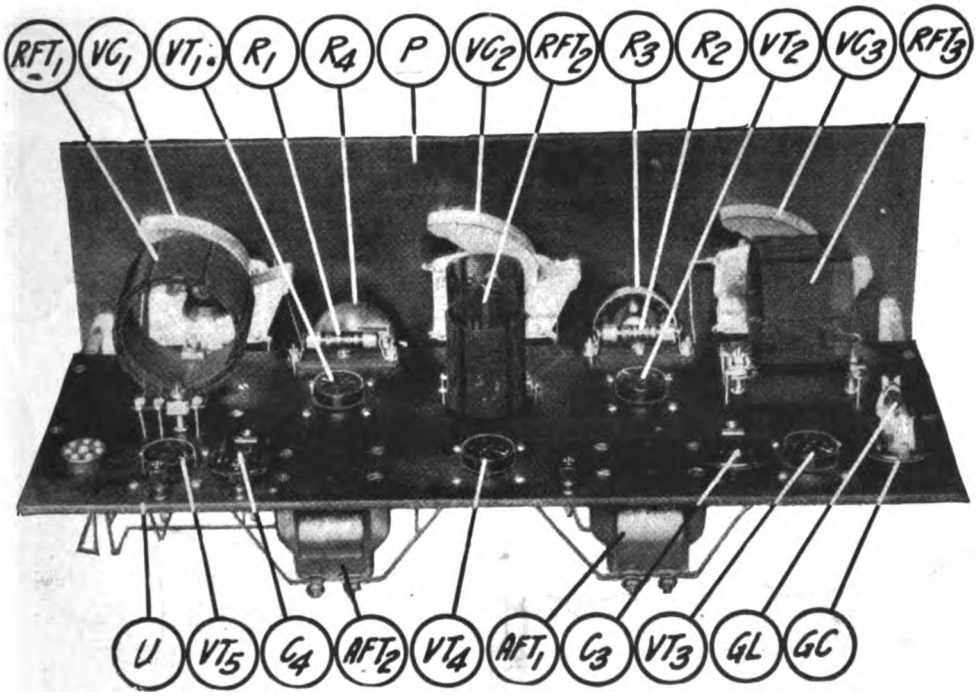


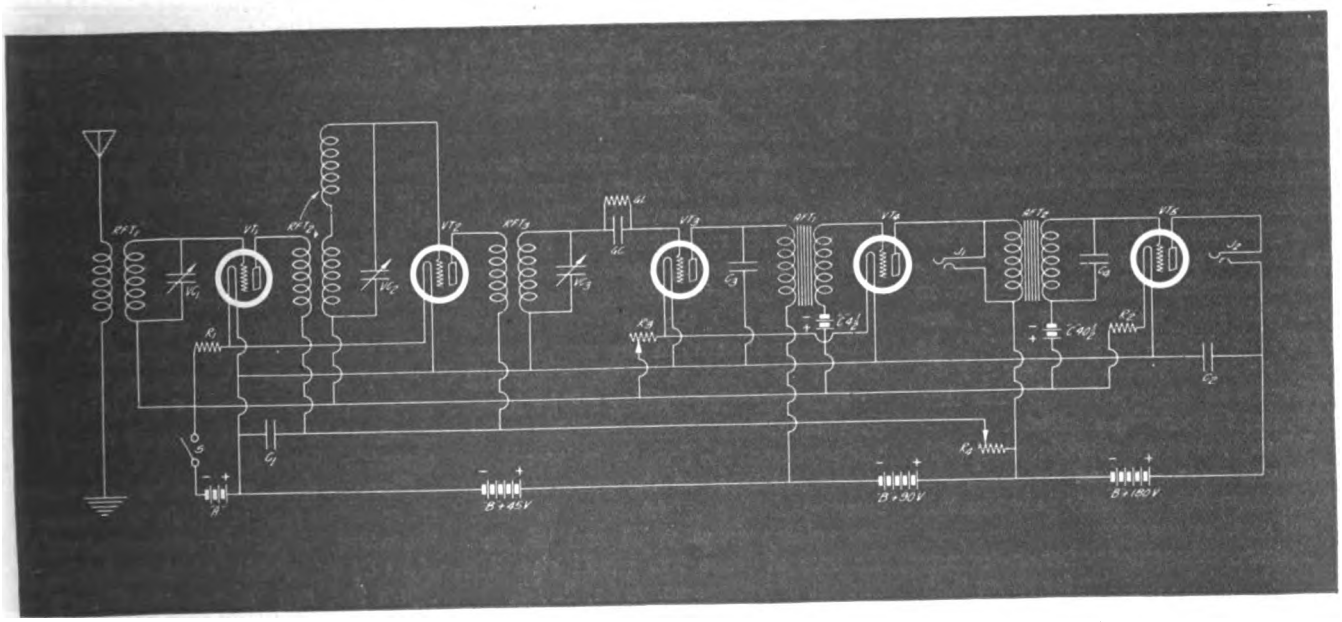
The Improved "Controllodyne" Circuit

This receiver consists of two stages of high-frequency amplification, a non-regenerative detector, and two stages of low-frequency amplification. Due to the construction and location of the coils employed, interaction is reduced so that the circuits are inherently stable. A high-resistance rheostat in the plate circuit of the first two tubes serves as an oscillation and volume control. Type UX-201-a tubes are used throughout except in the last stage, which utilizes a UX-171 type power tube.

The Parts that Are Recommended for Use in This Receiver Are—

RFT1 and RFT3—Benjamin "Lekeless" tuned-high-frequency transformers, No. 8621;
RFT2—Benjamin "Lekeless" tuned-high-frequency transformer, No. 9072;
AFT1—All-American low-frequency transformer, ratio 5 to 1, type R15;
AFT2—All-American low-frequency transformer, ratio 3 to 1, type R14;
VT1, VT2, VT3, VT4 and VT5—Benjamin UX-type sockets;
J1 and J2—Yaxley single-circuit jacks, No. 1;
VC1, VC2 and VC3—Benjamin straight-line-frequency variable condensers, .00035 mfd., No. 9061;
R1 and R2—Amperites No. 112;
R3—Yaxley rheostat, 10 ohms, No. 110-K;
R4—Centralab Radiohm, 200,000 ohms;
S—Benjamin battery switch, No. 86-40;
GL—Lynch metallized resistor, 2 meg.;
GC—Sangamo mica fixed condenser, .00025 mfd., with grid-leak clips;
C1 and C2—Tobe paper condensers, 1 mfd., No. 708;
C3—Sangamo mica fixed condenser, .001 mfd.;
C4—Sangamo mica fixed condenser, .00025 mfd.;
P—Insuline drilled and engraved front panel, 7 by 21 by 3/16-inch;
U—Insuline drilled sub-panel 7 by 20¼ by 3/10-inch;
2 Benjamin shelf-supporting brackets, No. 8629;
1 Jones multiplug, type PM;
3 Eby binding posts, two marked "C" (−), one marked "C" (+);
3 Marco vernier dials, scale zero to 100, No. 192.

Cost of Parts: $66.00.



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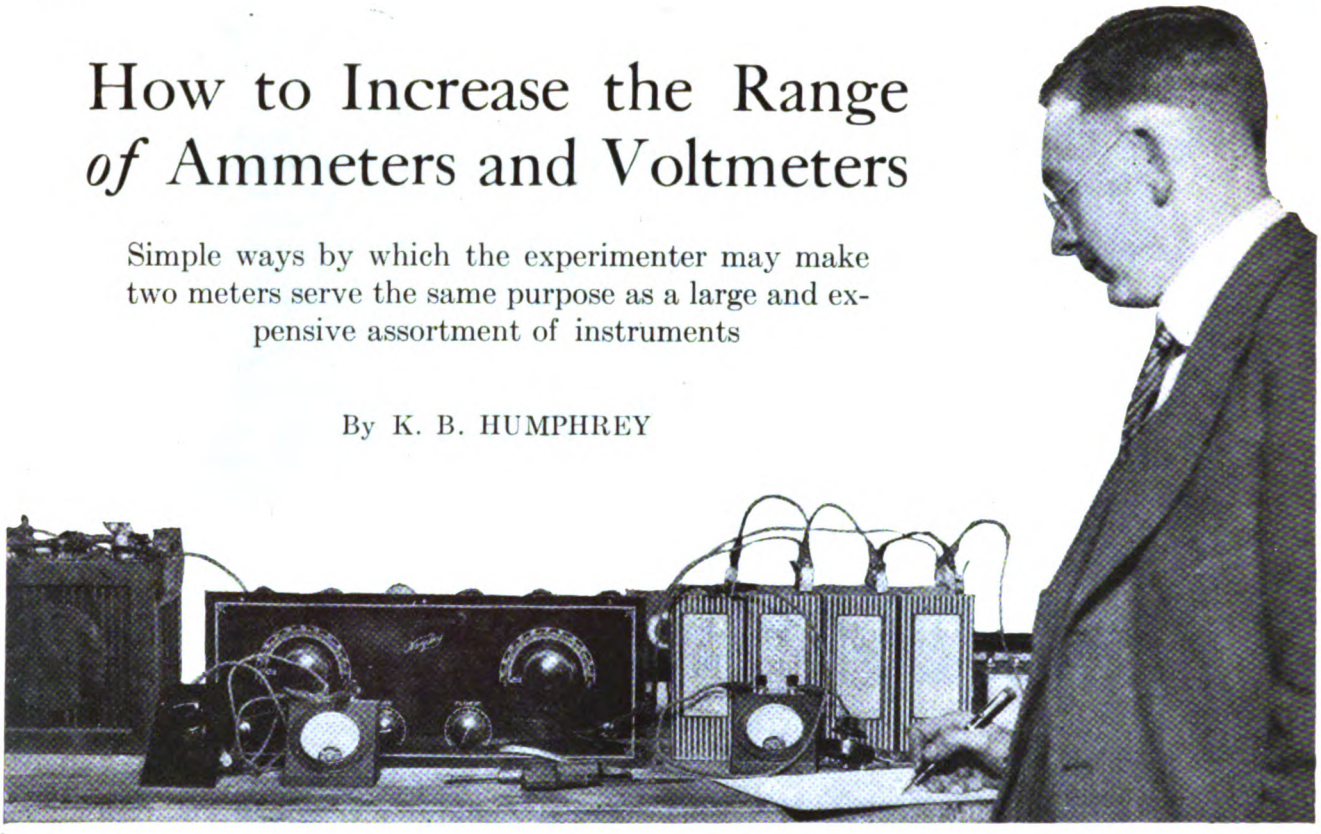
How to Increase the Range *of* Ammeters and Voltmeters

Simple ways by which the experimenter may make two meters serve the same purpose as a large and expensive assortment of instruments

By K. B. HUMPHREY



THERE is a growing tendency among radio fans to make use of various electrical measuring instruments in order to gain an idea of what is taking place in a circuit or combination of circuits and networks.

For the fortunate fan whose financial resources are not too limited it is an easy matter to purchase the correct instrument to make any measurement desired; the investment in meters alone may run into considerable figures. But for the majority, with somewhat limited means, one or two good instruments are all that can be afforded at one time. By a judicious choice of instruments however, and a knowledge of how their ranges may be increased or decreased at will, it is possible to make two instruments serve the purpose of several different ranges and thus do away with the necessity of buying a separate instrument for measuring different voltages and currents.

A great many of the measurements to be made in radio circuits are of a comparative nature. That is, the figures on the scale need not register volts, amperes, or milliamperes, but may be simply a reading such as 1.5 or 1.8; the difference in readings in this case then indicates the relative efficiency.

When it is at all possible, tests with standard meters should be made for comparison but for many purposes this is not at all necessary.

Either a voltmeter or an ammeter may be made to take readings far above their registered scales and with a fair degree of accuracy when combined with the proper resistances. These figures refer especially to direct-current meters, as they have a scale which is for all practical purposes uniform over the entire range for which they are calibrated.

How to Increase the Range of a Voltmeter

A voltmeter measures the voltage drop, or difference in potential, between any two points in a circuit. While there must be a small current flowing in order to get a reading, this current is so small in proportion to the voltage that it may be neglected in most cases, and does not enter into consideration except in a few instances such as the measurement of voltage from some source of supply which is limited (for instance, a "B" eliminator.)

Glancing at Figure 1, it will be noted that a voltmeter should be connected directly *across* the circuit. This meter has a certain resistance, say, R1.

If, as illustrated, another resistance is placed in series with the resistance R1 (such as R2), the voltage of the line will not be changed in any way, but the voltage as indicated by the meter will be changed. The reading will be lower because instead of measuring the entire voltage across the line, the voltage drop of the resistance of the meter only is measured. We might refer to these two voltage drops as V1 and V2, and the sum of these two would give the amount of voltage across the line V.

The voltage drop is directly in proportion to the resistances, and it may easily be seen that if we make the resistance R1 equal to R2 we have a condition where the meter will register exactly half of the voltage.

If, for instance the meter showed 50 volts when this arrangement was used, it would mean that the total voltage was 100.

This external resistance is known as a multiplier, and is often used where the voltage to be measured exceeds the scale reading of the instrument. Many manufactured instruments are made for which these multipliers may be obtained. A reading is taken and the result multiplied by the ratio of the resistances in each case.

While the resistances should be obtained from the manufacturer for the particular instrument in use a pretty fair result may be obtained in a very simple fashion.

Suppose, for example, we wish to measure voltages up to 100 and our voltmeter only registers 50.

Suppose again that we do not know what the resistance of the meter is.

In that case the meter may easily be calibrated by the use of a variable resistance placed in the circuit such as is shown in Figure 2.

To start with, we must have a source of voltage which is within the range of the meter. A battery is provided which gives 40 volts; this is just an arbitrary figure and any voltage at all may be

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used though it is usually best to take a voltage which is near the full scale reading of the meter in order to reduce the probable error. This reading is taken without the resistance in the circuit. The resistance is then cut in until the reading of the instrument is reduced to 20 volts or just half of the first reading whatever it might be.

We know now that the voltage has not changed from the source, yet our reading is just half what it was before. Multiplying by 2 gives us the actual voltage as first measured without the resistance.

Without in any way changing the value of the resistance, other voltages may be measured. But we must always remember to multiply the result by two in order to get the correct voltage.

If the voltmeter reading with the resistance set for half-scale deflection was found, in measuring an unknown voltage, to be 35, we would know immediately that the voltage was actually 70, or if it was 42 the voltage would be 84.

In a like manner the resistance may be adjusted until the reading is just one fourth of the total. In this case the multiplier would be 4 and with a reading of 35 the actual voltage would be 140 or in the case of 42 volts, 168.

The extreme range with a 50-volt meter would be 200 with a multiplier of 4. It may easily be seen that a small voltmeter of (say) 50 volts range may easily be used to measure voltages a great deal in excess of the rated scale reading. The better the meter in most cases the higher the resistance. For very expensive meters the resistances required in series would be considerable. The Carter Hi-Ohm variable resistance may be used for this purpose; doubtless there are many others on the market which would serve as well. *Caution:* after the resistance is once set for a certain multiplier, do not change it while readings are being taken.

How to Increase the Range of an Ammeter

An ammeter is built along the same line as a voltmeter but it is of low resistance so that the voltage drop across it is always kept small. This instrument may also be used to measure higher values of current by placing the correct value of resistance in shunt with it as shown in Figure 3.

The current flowing in a given wire is to be measured. Suppose we are using a milliammeter which is capable of registering only 25 mills and we want to measure 50 mills.

With a given voltage and some resistance in series with the circuit, so that the meter will not be burned out, a reading is taken with the milliammeter.

The shunt resistance is then placed at such a value that the reading is halved. That is if the reading were to be 20 mills the resistance should be adjusted until the reading is reduced to exactly 10 mills.

It might be noticed and viewed with alarm by some that the resistance of the circuit is being changed by the introduction of this resistance in shunt with the meter. However, it must be remembered that the reduction in the resistance of the circuit is small in proportion to the total resistance of the circuit and should not make enough error to disqualify the results except in the case of extremely fine precision measurements. In reducing the current through the meter by half the other half is going around the meter *via* the shunt resistance and now currents of twice the strength may be measured by simply multiplying the reading by two.

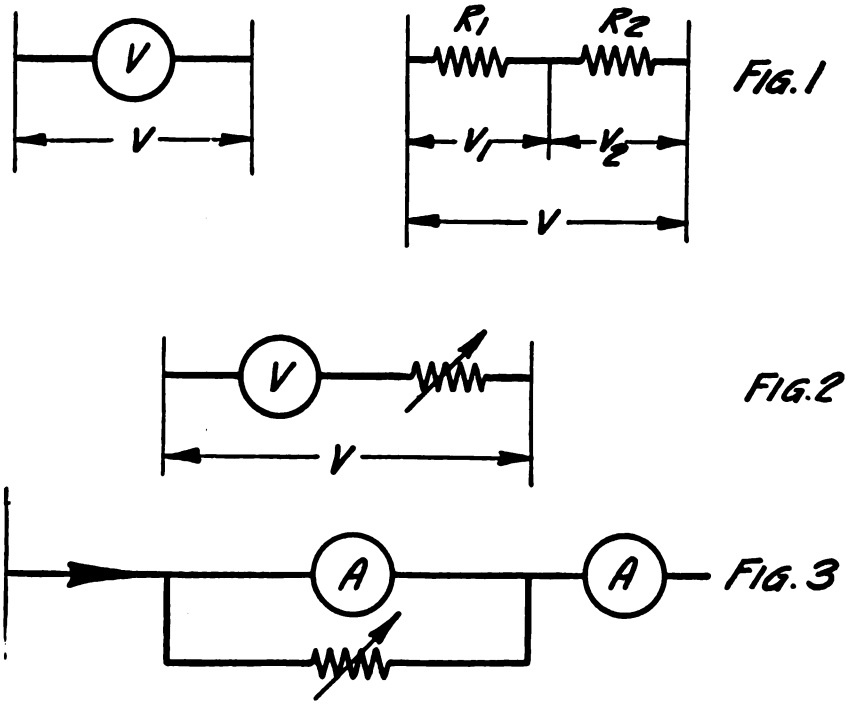
In a like manner other multipliers may be found, though as a rule the higher the multiplier used the more likelihood there is of errors being introduced into the measurement.

(It might be well to state here that meters of the more expensive type are manufactured which have a large number of different shunts to go with them by means of which extremely accurate results may be obtained).

Another way of calibrating the low-reading meter is to place a higher reading instrument in the same circuit, as shown in Figure 3, and then calibrating directly. This involves the borrowing of another meter or the purchase of one, and for most practical purposes is not at all necessary. The resistance to be used in shunt may be of the ordinary low-resistance type of rheostat used in a receiving set. For a milliammeter shunt an ordinary 5-ohm rheostat serves the purpose while a lower resistance should be used where an ammeter of higher reading is to be employed in this manner.

Care should be taken that the resistance used is of sufficient capacity so that no heating will result; otherwise the resistance of the rheostat may vary slightly with each change in temperature and the results thrown off accordingly.

Thus it may be seen that the experimenter who is limited to a small number of instruments may still do a great deal with only two low-reading instruments when they are properly hooked up with suitable resistance. In fact, it is possible to get a number of desirable combinations that may help any fan or experimenter to conclude experiments which at first glance might seem entirely beyond the range of the instruments on hand.



HOW METER RANGES MAY BE INCREASED

Figure 1 (top left) shows a voltmeter connected across an electrical circuit to measure the voltage, V, across that circuit and (top right) two resistances in series across a similar circuit with the voltage divided equally between the two resistances. In Figure 2 a voltmeter has been substituted for one of the resistances; the voltmeter is now capable of measuring double the voltage that its scale indicates. Figure 3 shows an ammeter with a resistance shunted across it to obtain higher readings; it may be calibrated by means of a second ammeter in series with the first ammeter and its resistance.

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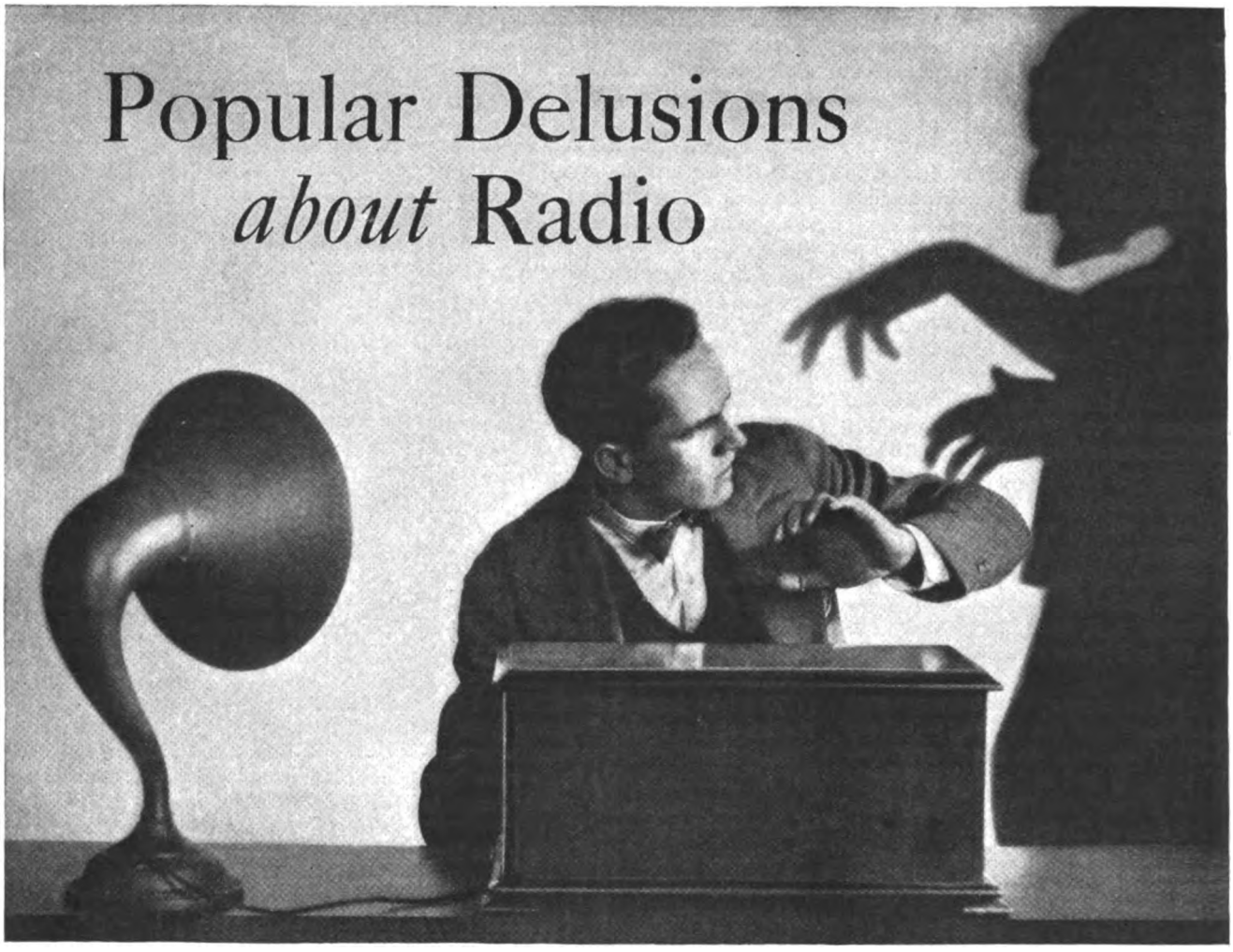
Popular Delusions *about* Radio



By CHARLES MAGEE ADAMS

MOST of us have been assured since childhood that if we touch a toad we will get warts. We have been told that "lightning never strikes twice in the same place," we have been warned that the combination of fish and milk is poison, and that when a swimmer has gone down for the third time his case is hopeless. Most of us have since learned that these statements are popular delusions—misstatements which have been repeated so long they have come to have almost the weight and authority of truth.

So perhaps it is only natural to find that radio is encrusted with a good collection of such delusions also.

Even experienced engineers have fallen victims to some of these misconceptions. It is to be expected that when the layman is regaled with one or more of these various delusions, he is not in a position to challenge its accuracy. Often, no particular damage results, either to him or his equipment, but there is frequently a considerable loss of time and sometimes valuable apparatus is discarded or ruined.

It is the purpose of this article to point out some of the commonest of these popular delusions.

The delusion most frequently encountered has to do with reception conditions. And chief among these is the delusion that distance reception is possible only late at night.

I have frequently tuned in KGO, the powerful California station, at nine o'clock in the evening, from my home in Milford, Ohio. Other listeners have doubtless had similar experiences. Distance reception is apparently better late at night only on account of certain contributing causes.

For eastern listeners, one of these is the difference in time.

Obviously it is impossible to tune in a station when it is not on the air, and most of the Pacific-coast transmitters do not get into action till late in the evening because of the three-hour difference in time.

Further, nearby stations that operate on wavelengths which interfere with distant broadcasters are usually off the air late in the evening, and local interference is generally at a minimum. This interference includes noises caused by electrical appliances and street cars, and such distractions about the home as talking. The absence of house-noises alone often makes it possible to bring in a far-away station that might have been considered inaudible earlier in the evening.

It should not require an expert to prove the fallacy that atmospheric conditions are better simply because the hour is late. Everyone has had the experience of getting good distance at dusk, only to discover that this has shrunk materially at eleven o'clock. The chief physical condition necessary for distance-reception is darkness along the entire path the signal is to travel—and even this theory has been seriously threatened by some remarkable daylight records.

So if you have been sitting up late because someone told you there is a magic quality in midnight air that makes distance reception better, simply go to bed and forget it. Provided the conditions mentioned are right, you can be sure of getting as much "distance" early in the evening, as the fellow who stays up till the wee small night hours.

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Another widespread delusion about reception conditions is that the greater the amount of static, the less the signal strength, and *vice versa*.

There is just enough truth in this to make it seem entirely true.

In many cases signal strength *does* decrease as static increases, and it *does* increase as static decreases. But far from always, and not as the only cause or effect. Last night, for example, "the old man of the ether" was venting his wrath in explosive bursts like machine-gun fire; yet a dozen out-of-town stations came hammering in even more energetically than the static; three nights before, with the air practically silent, these same stations had been mere whispers, when they came through at all.

The truth is that static is only one of several atmospheric forces that affect reception; while it may be unfavorable to reception these other forces may be favorable too—or *vice versa*. So no rule that will hold can be laid down regarding static as compared with signal strength.

The same is true of the often repeated assertion that "the colder the night the better the reception." This delusion is, of course, based on the fact that distance reception is better during winter than summer. But, as anyone familiar with radio should know, it does not follow that, once winter has set in, reception improves as the thermometer falls. Just recently a friend, testing a home-made receiver on a night so warm that it should have rated 2 percent for radio according to the temperature rule, tuned in a tiny 10-watt station 900 miles away!

The familiar generalization that clear nights are best for radio, too, fares no better when put to the test. Every listener must have noticed that rainy nights, apparently hopeless for reception, have often turned out to be excellent. In my own case the supreme thrill of getting California for the first time came on a night when the air was full of a sticky snow.

We know so little about the effect that weather and atmospheric conditions have on radio that nothing like a hard and fast rule can be laid down.

Most conspicuous among another class of radio delusions are those concerning the "radiating" or "re-broadcasting" receivers.

"Yes, I've only got a crystal outfit, but I get good distance. One of the neighbors has a big tube set, and he re-broadcasts the out-of-town stuff for me," summarizes a familiar form of this delusion.

What is meant, of course, is that the neighbor has a regenerative receiver that oscillates, radiating exactly as if it were a small transmitter. But in spite of the popular assumption, *it is impossible for a set of this type to re-broadcast any program it is receiving*, because the oscillations that it would radiate would be out of phase with the original signals. Accordingly; instead of making reception in the neighborhood better, this type of set makes it considerably worse with its whines and whistles.

The explanation of results attained with crystal receivers, like those referred to, is simply that the out-of-town stations happen to be coming in with such volume that even crystal sets can pick them up.

"Of course he gets better results than than I do; he has an eight-tube set, and mine's only a five." How many times has a statement of this sort been made —and accepted?

This too contains just enough truth to be dangerous. Given equal excellence of design, construction, installation and operation, the number of vacuum valves in a receiver offers an approximate indication of its efficiency; but *only if these other items are equal.*

It has been demonstrated, for example, that a well-designed, well-constructed five-valve set, properly installed and in the hands of a skillful operator, can show all-around results superior to those secured by a poorly designed, cheaply-constructed eight-tube receiver, in an unfavorable location and clumsily handled.

So instead of judging a set by the number of tubes, try to estimate its value on the basis of how well it makes use of its tubes. No intelligent buyer attempts to rate a car merely according to how many cylinders it has; and giving the number of valves in a radio set the same importance can easily be as untrue.

Another group of generally accepted radio delusions has grown up about the installation of receivers. As an instance, a man of my acquaintance risked his neck to fasten his antenna to a hundred-foot smokestack, because he had been told the higher it was, the better his results.

It is true that an antenna should be high enough to clear surrounding objects, particularly metallic structures likely to absorb signal power. But under normal conditions, especially outside closely built cities, 30 or 40 feet is ample. And even this height is not always essential.

The results attained by the man just referred to were little, if any, better than those with antennas 25 and 30 feet high; the efficiency of antennas as low as 15 feet has often proved so good

(*Continued on page 280*)

Eight Common Fallacies

1. *That long-distance reception is possible only at night—*
2. *That the greater the static is, the less is the signal strength—and vice-versa—*
3. *That the colder the night is, the better is the reception—*
4. *That a regenerative receiver can "re-broadcast" a program—*
5. *That a receiver with six or eight tubes must necessarily get better results than a set with four or five tubes—*
6. *That a long or a high antenna is more efficient than a short or a low one.*
7. *That better reception is attained by the burning of filaments of vacuum tubes to the limit—*

AND—

8. *That distant programs are better than local programs.*

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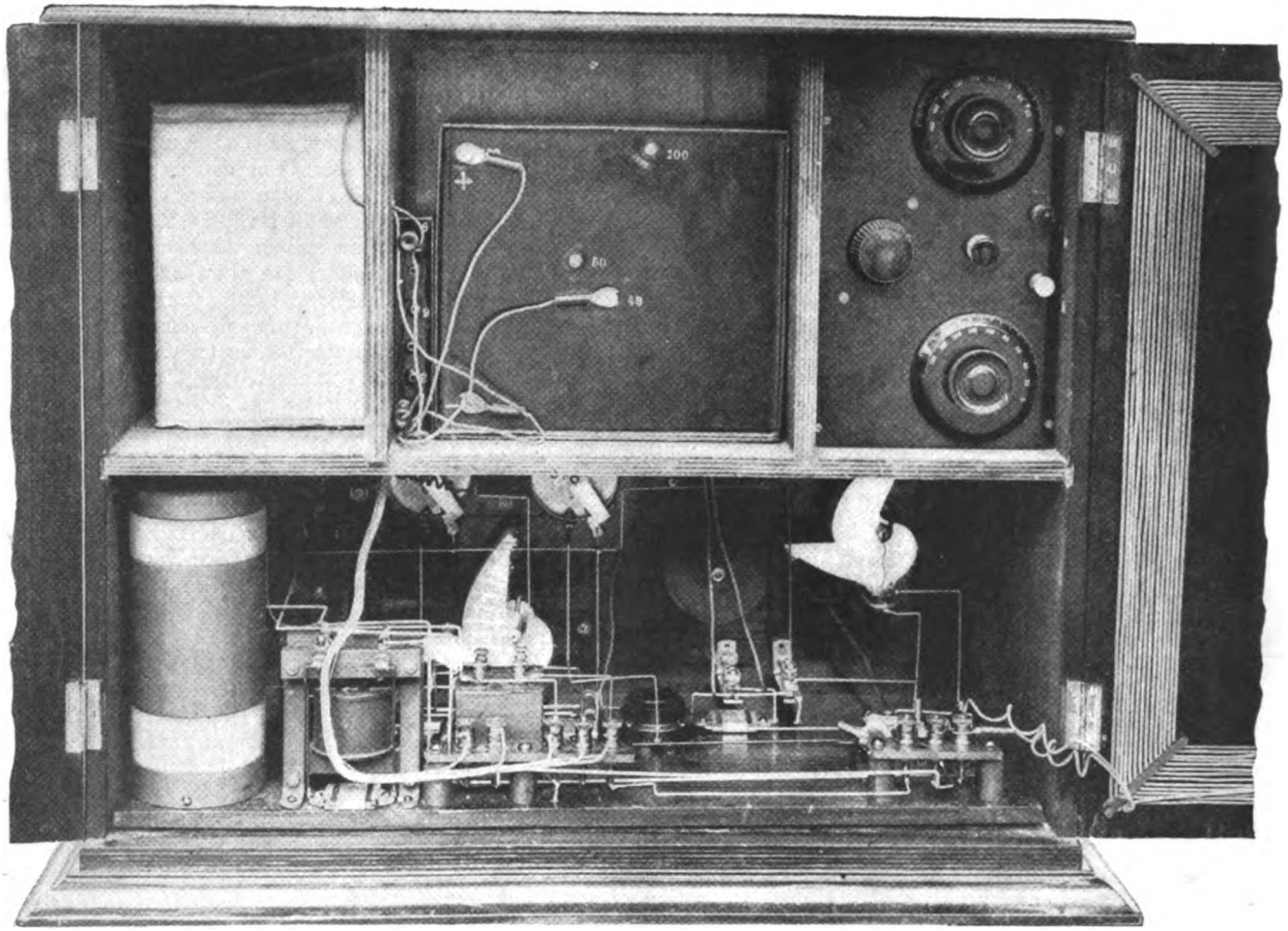

A REAR VIEW OF THE INVENTOR'S OWN MODEL

The layout of this set is typical of British set construction in which the receiver proper is located in the lower part of the cabinet with the batteries and auxiliary devices in separate compartments. The loop is suspended on a hinged door with flexible leads taken off for connections; this is shown at the extreme right.

The Unique "Retrosonic" Receiver

The tremendous amplification obtained by means of the novel circuit in this new three-tube receiver which has excited the radio fans in England is mysterious to the inventor himself—for even he is not sure of the actual theory of operation. Read this article and see if you can explain how this receiver works.

By A. DINSDALE

FROM time to time radio experimenters achieve astonishing results by the use of unconventional circuits, which, according to all generally accepted theories, should not work at all. But they do work—and that fact frequently impells people to exclaim about the discrepancies between theory and practice.

Theory, of course, is generally in advance of practice, but occasionally practice catches up and something is demonstrated for which there is no ready-made theoretical explanation.

The Retrosonic receiver is a case in point.

Much has been heard of this receiver recently in England, and it was shown at the annual radio exhibition this year at Olympia; but no details have hitherto been available. Now, however, with the publication of the patent specification* covering the principles involved, it becomes possible to describe the circuit in detail.

The Retrosonic receiver is the product of Mr. H. W. Roberts, an amateur radio experimenter of Sheffield, England. The chief claim made for the circuit is an unusual range combined with an unusually high degree of selectivity. Only three tubes are employed; no reflexing, as generally understood, is used yet the results obtainable compare favorably with those given by a superheterodyne.

*British Patent No. 256,998.

Unusual Features of the Retrosonic Receiver Circuit

The circuit of the Retrosonic receiver is shown in schematic form, in Figure 1.

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From this circuit it will be seen that, so far as selectivity is concerned, the characteristic feature is the tuned loop circuit, 9 and 10, which appears in the center of the circuit diagram. At first glance this seems to be an ordinary rejector or trap circuit, or tuned plate coupling. It may be all of these; but there is some peculiar characteristic attached to it which the inventor himself cannot adequately explain; and it is this characteristic which gives the set its extraordinary selectivity, a degree of selectivity much greater than that usually obtained with a similar form of trap circuit in an ordinary receiver.

The second feature that calls for comment is the fact that although the circuit is not reflexed, in the ordinary sense of the term, some form of feed-back undoubtedly takes place between adjacent tube circuits which is not of the ordinary kind.

Another interesting point is that the second tube appears to function without any direct application of "B" power voltage to the plate.

It is apparent also that the "B" power is short-circuited through the windings of the loudspeaker or telephones and the primary winding of the low-frequency transformer, 15. This, however, is not of very great moment, for the combined resistance of the phones and transformer winding is extremely high.

Finally, the most extraordinary feature of all is that there appears to be no detector! It is certain that the last tube is a low-frequency amplifier, yet there is a species of high-frequency coupling between it and the tuned loop circuit, 9 and 10.

Tracing Signal Impulses Through the Circuit

In an effort to understand the operation of the circuit, let us trace the progress of signal impulses through it.

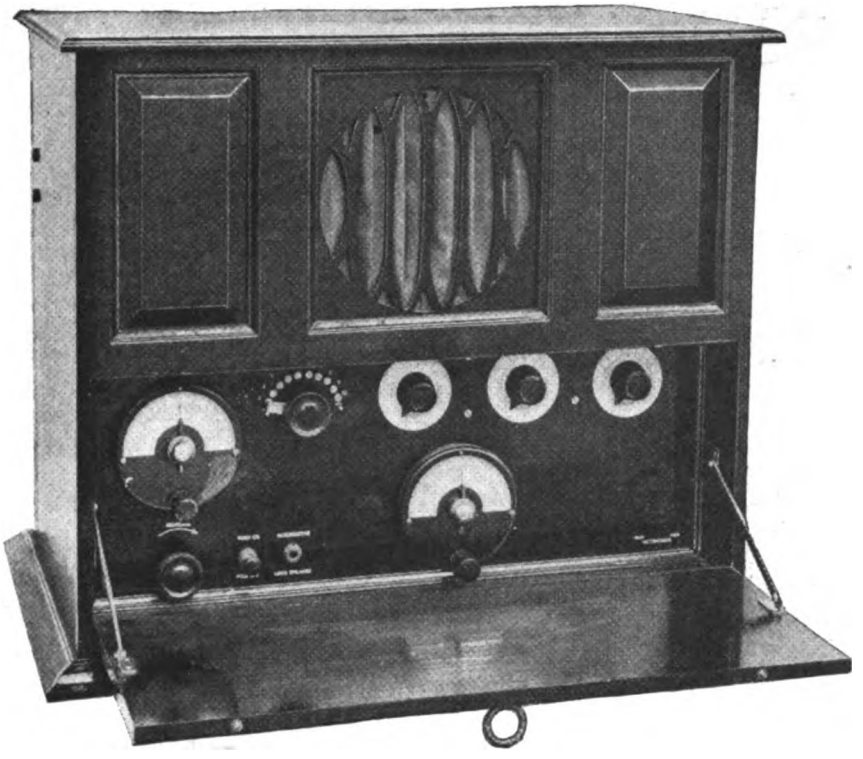
Commencing at the antenna, it will be seen that the tapped inductance, 5, conveys the incoming impulses directly on to the grid of the first tube through a biasing battery, 8. Considering the first tube as a high-frequency amplifier only, amplified high-frequency currents will flow through the tickler coil, 12, which is in the plate circuit of the tube.

At the same time a part of the antenna energy, reinforced by regeneration from the tickler coil, 12, will find its way from the grid coil, 5, to the tuned loop circuit, 9 and 10, *via* the single direct lead, YY, and the loop circuit will thus be impulsed as well.

In other words, the single point connection through the lead, YY, from the grid of the first tube to the loop circuit, 9 and 10, conveys voltage impulses which build up, by resonance effect, into an oscillatory current of considerable magnitude inside the loop circuit, provided the latter is exactly tuned to the frequency of the incoming signal.

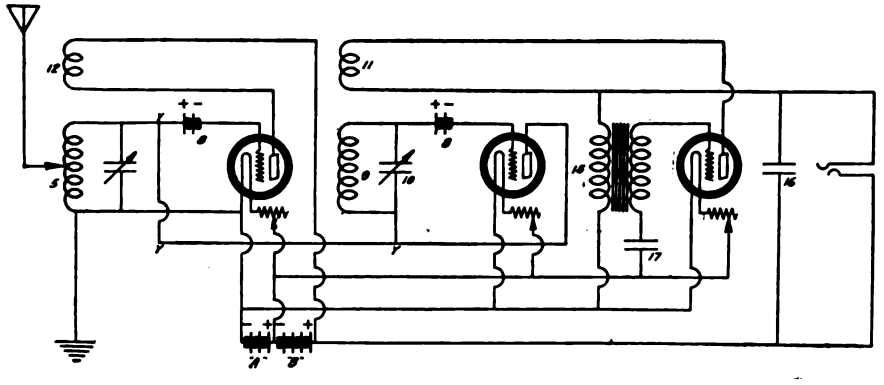
Thus, large voltages will accordingly be induced across the coil, 9, which are then applied across the grid and plate of the second tube. Correspondingly amplified currents may therefore be expected to flow in the plate circuit of that tube. It will be noticed that the grid of the second tube is also biased. This is done to neutralize any possible tendency for a positive potential to be impressed upon the grid by virtue of the biasing battery of the first tube, for there is a circuit between the positive terminal of the first grid-bias battery and the grid of the second tube.

Coupled to the coil, 9, is another coil, 11, which is in the plate circuit of the third tube. A form of high-frequency coupling results, so that impulses circulating around the tuned loop circuit induce similar currents in the coil, 11. These currents, flowing through the primary of the low-frequency amplifying transformer, 15, produce similar currents in the secondary winding, which are then impressed upon the grid of the third tube. The plate of this tube, it will be observed, is provided with a high-frequency path through the loudspeaker shunting the condenser, 16, and the tickler coil, 12, back to the plate



A FRONT VIEW OF THE RECEIVER

The arrangement of the tuning dials and auxiliary controls of the receiver itself are shown here. Notice that the cabinet contains a loudspeaker behind a grilled lattice-work in the center compartment.



THE SCHEMATIC DIAGRAM OF THE CIRCUIT

FIGURE 1: *In this set, the second tube in not supplied with any direct potential but is connected back to the grid circuit of the first tube for its source of power. The first tube seems to act as in a straight regenerative circuit. The plate circuit of the last tube is coupled to the grid circuit of the second tube, which has, at the same time, a tuned input circuit.*

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of the first tube, as shown in Figure 1.

For many years it has been known that thermionic tubes, no matter whether used for high-frequency or low-frequency amplification, have a tendency at the same time to rectify or detect signals to a certain extent, and particularly so when they are overloaded. On account of this fact it has been suggested that, in the case of certain multi-tube sets, signals are already half detected before the detector is reached, and the condition, spread over the entire circuit, is known as cumulative rectification.

There is no detector provided for in the Retrosonic circuit, as the reader may see from the circuit diagram, yet signals are detected or rectified on this receiver.

Such high-frequency impulses as are applied directly to the grid of the first tube are rectified owing to the presence of the grid-bias battery, 8, what is known in England as "anode bend" rectification being the result. In this method of rectification, which does away with the conventional grid-condenser and grid-leak (which introduce damping and thus cause distortion and lack of selectivity), the grid of the tube is negatively biased so that it operates at the lower bend of its characteristic curve. Positive half cycles then carry the grid potential up the curve, while negative impulses are cut off altogether, thus effecting rectification.

Partial rectification occurs again at the second tube, where any high-frequency impulses reaching the grid will be rectified for the same reason as in the case of the first tube—because of the grid-bias battery.

Finally, a blocking condenser isolates the grid of the last tube, which again tends to cause partial rectification. Signal impulses therefore appear to gradually rectify themselves as they progress through the set.

That being so, we must revise our description of the progress through the set of received impulses, for the process is now complicated by the introduction of low-frequency currents into circuits which before we only considered as carrying high-frequency currents.

Thus, rectified or low-frequency impulses from the output of the first tube will flow through the tickler coil, 12, and because this is coupled to the coil 5, are partially transferred to the coil, 5, giving rise to a species of low-frequency regeneration between the grid and plate circuits of that tube.

Also, some of the low-frequency cur-

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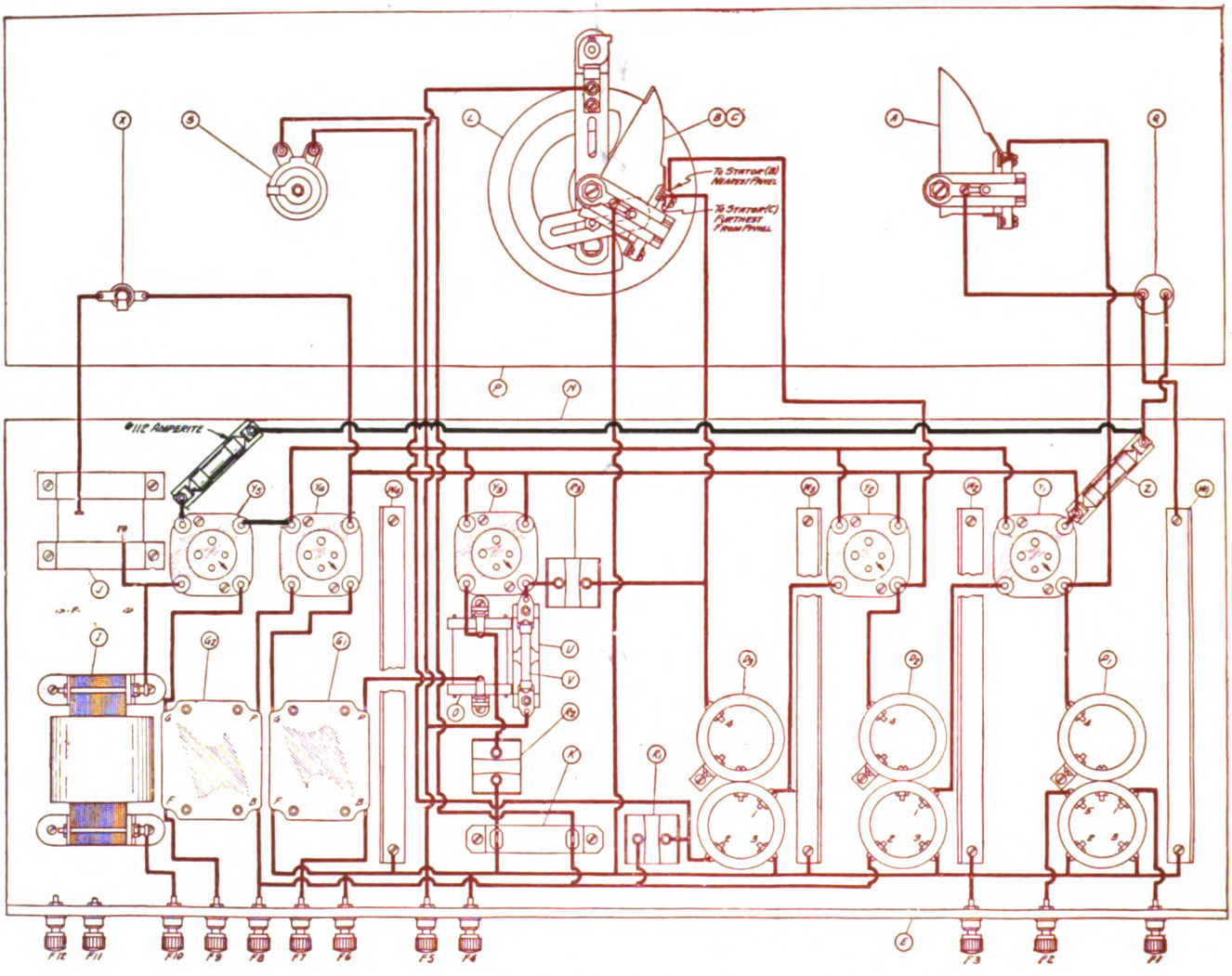

How to Adapt the LC-27 Receiver for Use with UX-171 or UX-112 Type Tubes

The diagram in red shows the original connections for the LC-27 receiver except that the filament circuit of the last tube has been omitted. The heavy black lines show the connections for the ½-ampere automatic filament control that should be added when the set is to be used with the UX-171 or the UX-112 type power tube in the last stage of low-frequency amplification.

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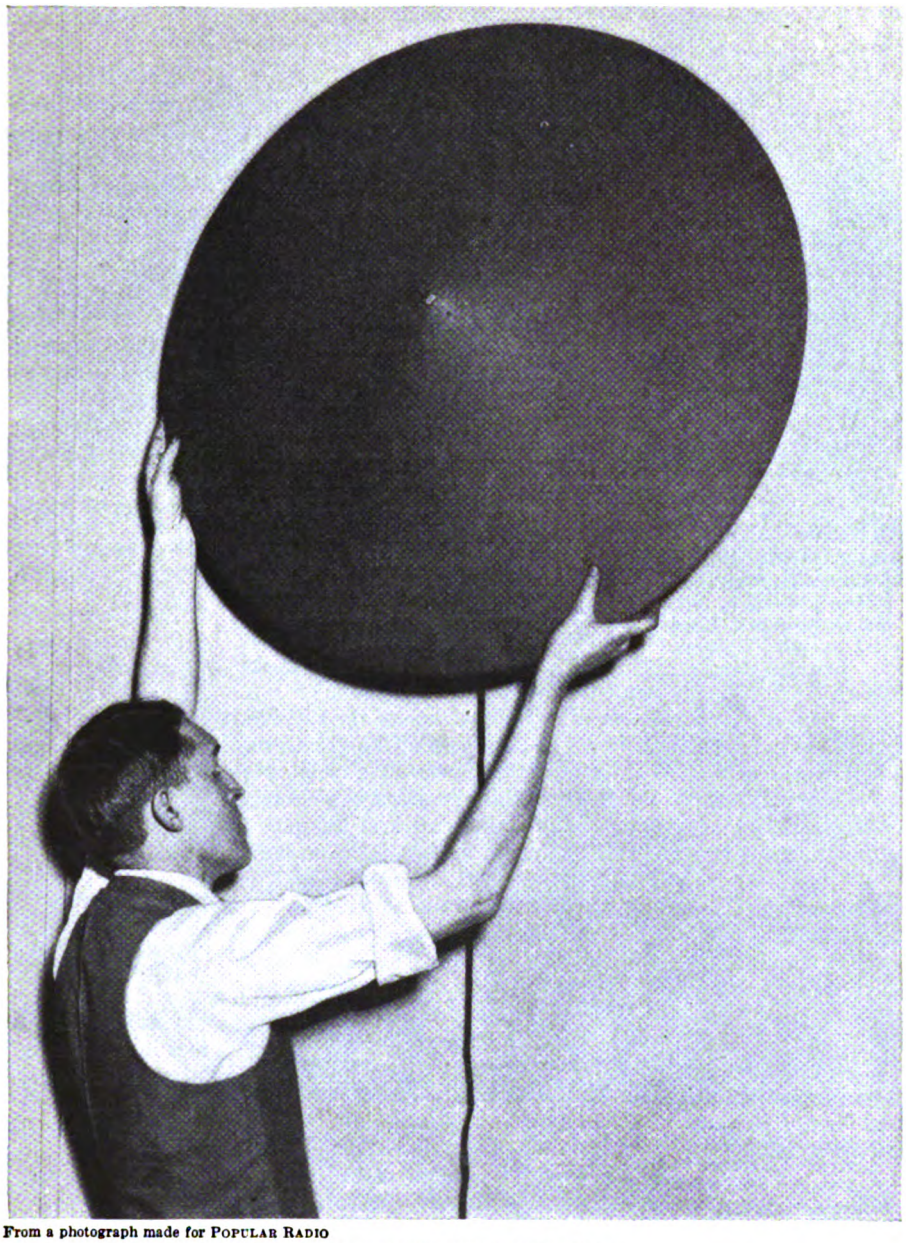

From a photograph made for POPULAR RADIO

THE FINISHED PRODUCT

After the loudspeaker has been built and the unit adjusted, it should be hung high on the wall—or from the ceiling—out of harm's way, by means of the small hook on the back.

HOW TO BUILD YOUR OWN 36-INCH

CONE LOUDSPEAKER

By LAURENCE M. COCKADAY

THE PARTS REQUIRED FOR BUILDING THE CONE REPRODUCER—

A and B—one package of Fon-O-Tex paper for the discs, A and B;
C and D—two back rings, stamped and drilled ready for mounting;
E—one Penn reproducer unit, equipped with three mounting brackets, bolts, nuts, washers and other accessories;
F—one can of special Ambroid cement.

UP to the present time the experimentally inclined radio fan would have had little success in trying to build a reproducer of the cone type—because he has had neither the proper design for laying out the paper cone nor the facilities for mounting a reproducer unit within the apex of the cone itself.

Although there have been several efficient reproducer units on the market, few of them have been easy to mount on a cone. Furthermore, they have not been equipped with a suitable "pin" for attaching to the cone apex itself.

By coordinating the efforts of manufacturers of the proper kind of parchment paper and the manufacturers of reproducer units especially made for use in cone reproducers, as well as of manufacturers of smaller accessories in building the cone reproducer, the

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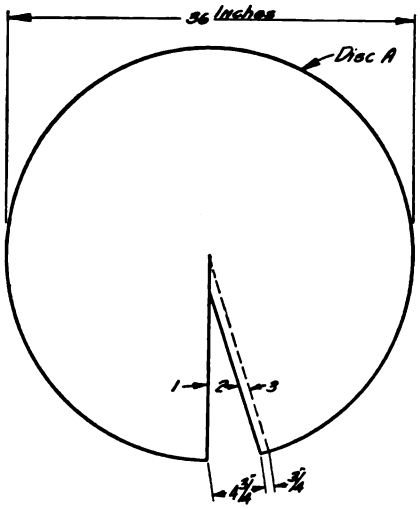


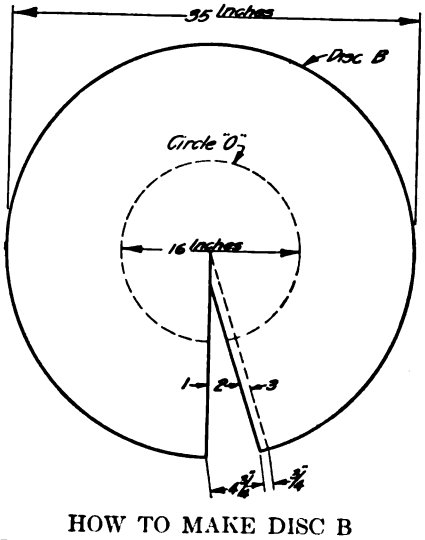
HOW TO MAKE DISC A

FIGURE 1: *The front disc of the cone should be cut out exactly as shown above. First cut out the circular piece with a diameter of 36 inches; then cut out the segment that lies between the heavy lines, 1 and 2. To form the cone, line 1 is then cemented directly over line 3.*

POPULAR RADIO LABORATORY has at last made it possible for the experimenter to make a good cone, that will reproduce the low tones with great volume and fullness, and that may be built by any one.

Only four tools are necessary; (1) a pair of scissors, (2) a small paint brush, (3) a screw driver and (4) a ruler.

After the parts listed at the head of this article have been procured, the fan should prepare the paper cutouts for the front and back of the cone, as illustrated in Figures 1, 2, 5 and 6. The kind of paper used for this purpose comes in sheets 38 inches square. Two



HOW TO MAKE DISC B

FIGURE 2: *The back disc of the cone should be made in the same manner as disc A; the disc, however, has only a 35-inch diameter. The circle, O, should be marked before the cone is formed; but it should not be cut out until after line 1 has been firmly cemented over line 3.*

of these sheets are required for cutting the circular discs, A and B, in the making of the cone.

How to Make the Disc A

First, lay one of the sheets of paper flat on a large table and with a long ruler determine the exact center by drawing two lines criscross from one corner to the opposite corner.

Then draw a circle, using the center already laid out, exactly 18 inches in radius, thus making a disc 36 inches in diameter (see Figure 1). Cut out the disc with a sharp knife or razor blade or with a pair of sharp scissors, making an even and clean cut as shown in Figure 5.

Next, prepare the slit as shown in Figure 1.

Examine the surface of the paper and you will notice some streaks, rather darker in color than the rest of the surface, running in one direction. Be sure that the slit is laid out in pencil in the direction in which the streaks run. Then draw the first line of the slit, No. 1, from the periphery of the disc to the center and then measure a point 4¾ inches from this slit along the circumference and make a mark at this point.

Then measure further, ¾ of an inch, and draw a line, No. 3, from this point on the periphery to the center.

Next, draw another line, No. 2, running parallel with line No. 3, until it hits line, No. 1; then cut along line No. 1 and cut out the portion of the radius that lies between lines No. 2 and No. 1 with a single straight cut along line No. 2 (see Figure 1).

Then punch a ⅛-inch hole exactly in the center of the disc. When this is done cement the edges of the slit together so that line No. 1 covers line No. 3. This should be done with Ambroid cement. (See Figure 6.)

Next, remove the nose piece from the reproducing unit, E, and cement the large brass disc to the inside of the apex of the cone, A, exactly centered over the hole. Cement the smaller brass disc in the same way over the outside of the apex of the cone.

The front cone, A, is ready and you are now ready to prepare disc B.

How to Make Disc B

Prepare the second disc, B, in a similar manner to disc, A, following the instructions given in Figure 2; but do not cut out the center portion shown by the dotted circle, O, until the slit made by lines No. 1, 2 and 3 have been cut and cemented firmly together. Then cut out the dotted line, O, with a sharp-pointed pair of scissors. This leaves an outside rim of a general cone shape. The 16 inch circular disc that is left in the center is not used.

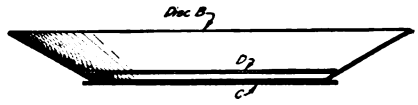
How to Mount the Back Rings, C and D, on Cone B

Place the back ring, C, on the floor or on a large level table where there is plenty of room to work. Cement the top surface of this ring, C, with the Ambroid cement and place the disk, B, quickly on top of it, being careful that it is centered properly. Press down around the inner edge and set weights around the inside edge of the cone disc, B, until the cement has dried properly, and the back ring, C, and the disc, B, are firmly held together.

After the cement has hardened, cement the second ring, D, to the inside of the cone, making sure that the edges and the four round holes meet exactly. See Figures 3 and 7 for this operation.

How to Fasten the Two Discs A and B Together

First, we will have to prepare a support for the large cone to set in with its apex facing downward, as shown in Figure 4. Take an old hat box or other



HOW THE BACK RINGS ARE INSERTED

FIGURE 3: *The back rings, C and D, are cemented firmly to outer and inner surfaces respectively of the disc, B. Be sure that each ring is centered properly before it is cemented.*

cardboard box and cut a circle about a foot in diameter at one side, setting the apex of the cone, A, into the opening, so that the periphery is permanently level in a horizontal plane.

Then set the cone, B, into the cone, A, being sure that it is in an even position, with the edge of cone A projecting beyond the edge of cone B at equal distances all the way around. (See Figure 4).

Then pour the Ambroid cement all around the edge of the smaller cone where it touches the larger cone, A, being sure that all points are covered in a neat manner. (See Figure 8.) When the cement hardens, the two cones, A and B, will be fastened together solidly.

The next job will be to fasten the unit, E, by inserting it inside one of the openings in the back ring, and fastening with the bolts that are supplied, to the three extension pieces or brackets. (See Figure 9). The brackets will first have to be fastened in position, of course, in the three holes in the back rings, C and D. When the unit has been mounted screw in the threaded brass nose-piece into the unit, E, as shown in Figure 10. Then, pull the reproducer cord through the small hole in the center of the back rings, C and D.

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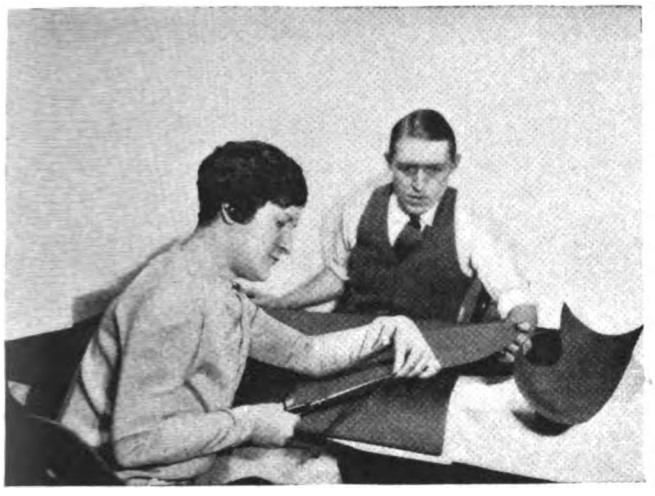
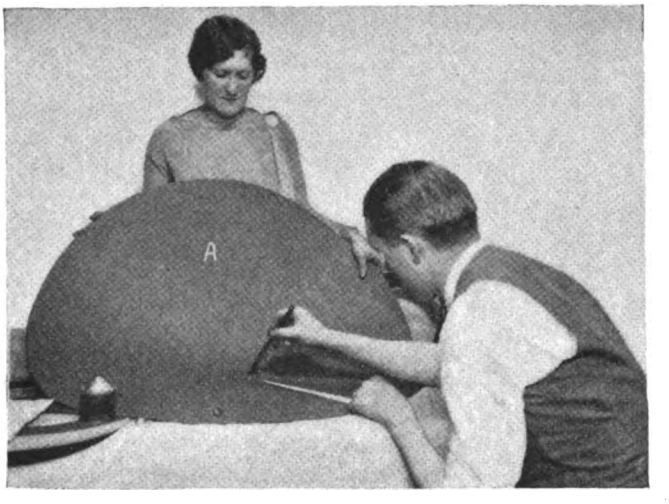
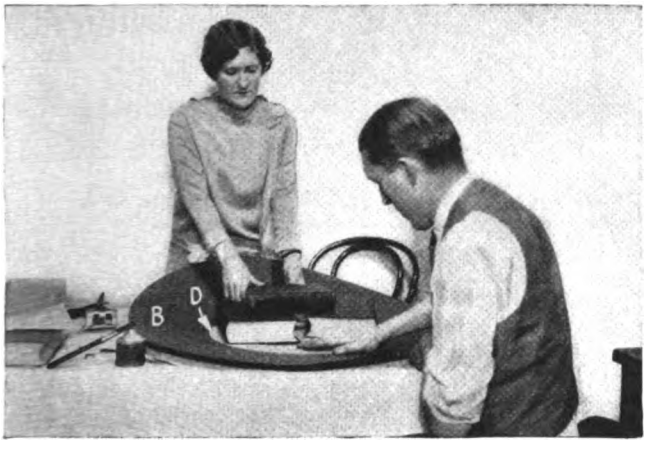


5 *After the cone paper has been marked in pencil, as shown in Figures 1 and 2, the two discs, A and B, should be cut out carefully with a sharp pair of scissors, and the segment cut out between lines 1 and 2 (of the diagrams).*

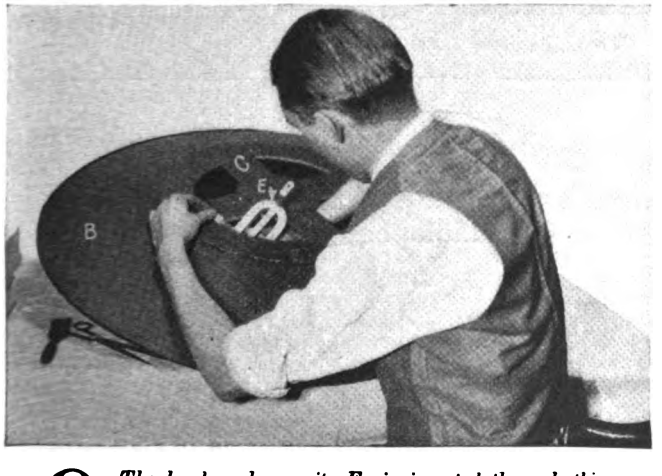


6 *The next operation is to form the cone by cementing together the edges on either side of the cut-out segment. The cement should be applied with a small paint brush and the two edges of the disc pressed tightly together.*

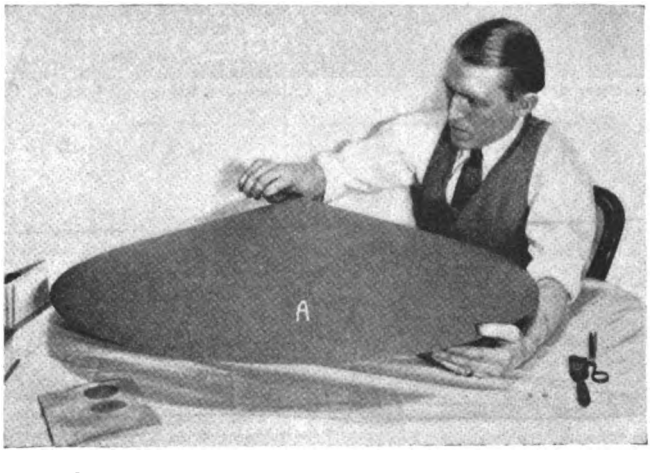


7 *After the circle, O, in cone B has been cut out, the two back rings, C and D, should be carefully centered over the hole that is left and cemented to either side of the disc. Two or three heavy books should then be laid on ring D until the cement has hardened.*

8 *To cement the two discs together, disc A is set in a support, as shown in Figure 4, and disc B is set carefully into it. The cement is then evenly poured around the rim of disc B at the point where the two cones meet; this fastens the cones together solidly.*



9 *The loudspeaker unit, E, is inserted through the back rings, C and D, to which it is fastened by means of three brackets and bolts. The brackets, of course, should be fastened to the rings before the unit is inserted.*



10 *Finally, screw the threaded brass nose-piece, as shown above, through the center of cone A, into the unit, E. The loudspeaker may then be adjusted by attaching it to the receiver and turning the regulating screw in the tip.*

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Courtesy A. T. & T. Co.

Herbert

The Nerve Centers of the Trans-Atlantic Radiophone System

From this gigantic antenna system at Rocky Point, New York, 7,250 feet long, the radio impulses that carry your voice from the telephone in your home, when you put in a call for London, are sent out across the Atlantic ocean to sensitive radio receivers and finally to telephones in homes and offices on the other side. At the left is one of the elaborate control boards at the radio station at Rugby, England, where radio messages on that side of the water are received and retransmitted by wire. Land wires carry the messages from the central telephone exchange in New York to the transmitting station at Rocky Point. The radio receiving station at this end is at Belfast, Maine. The opening of this service to the public on January 10, 1927, was attended by great success.

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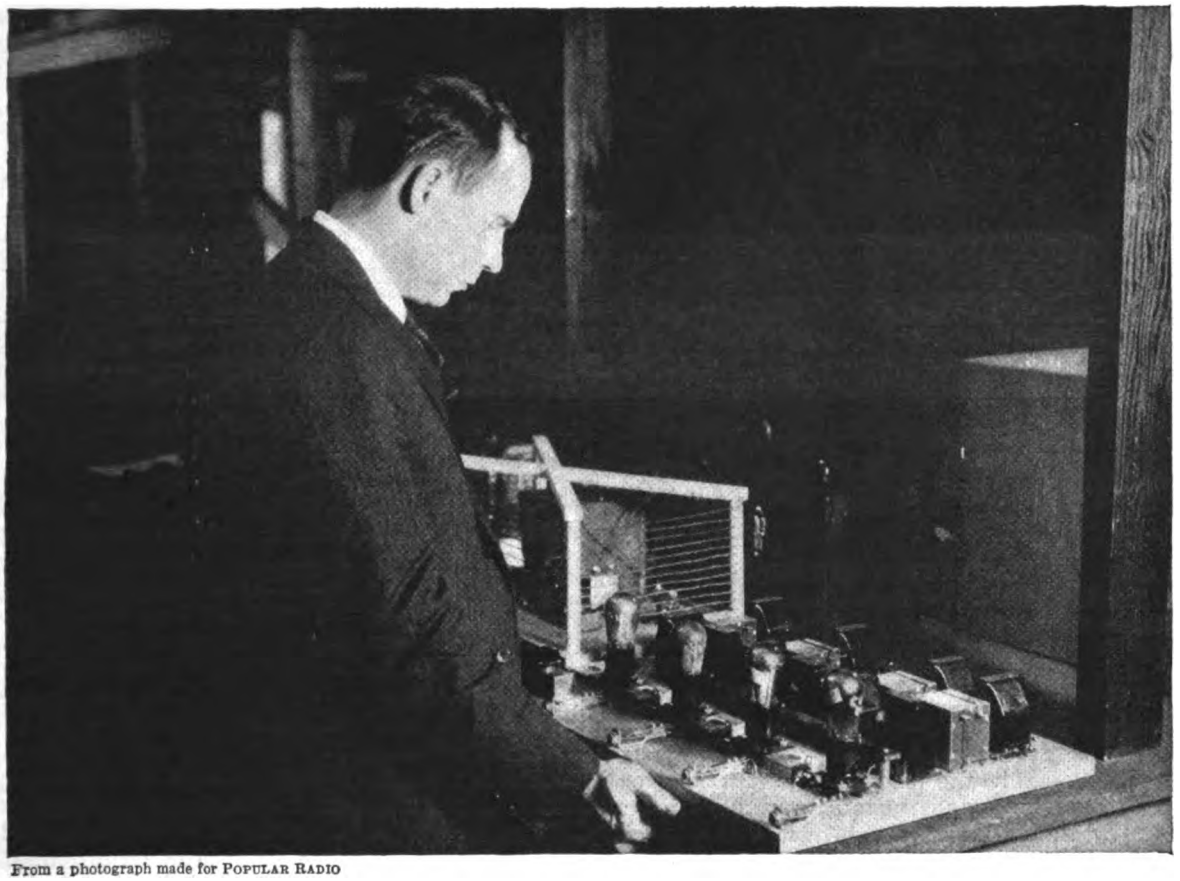

From a photograph made for POPULAR RADIO

TESTING A LOW-FREQUENCY AMPLIFIER IN THE LABORATORY

At the right of the picture may be seen a set-up for a four-stage low-frequency amplifier that Professor Bowles is investigating to determine its characteristics.

WHAT EVERY FAN SHOULD KNOW ABOUT

AUDIO AMPLIFIERS

The first article in a new series on the principles underlying truthful amplification and reproduction at low-frequencies—written by an authority in terms that everyone may understand.

By PROFESSOR E. L. BOWLES

WHEN a note on a violin is sounded, that note produces a certain effect on one's ears.

The note is made up of vibrations of audible frequencies; or, in general, it may be said to be made up of a fundamental tone and several "overtones," which are harmonics of the fundamental frequency. Sound frequencies are designated as low frequencies or audio frequencies.

If the fundamental frequency alone were present, the note would sound colorless. In fact, it is this composite nature of the note of a musical instrument that not only gives the note quality and character, but that distinguishes it from the same note on some other musical instrument.

So, in speech, it is the relative magnitudes of the harmonics or overtones that give quality and character to one's voice.

In broadcasting a program of any sort, the sound waves must first impinge upon what is called a microphone. This device transforms sound energy into electric energy, much as a generator in a power plant transforms mechanical energy into electrical energy. The microphone may be in the studio at the broadcasting station, or it may be at the point where a concert is being given, or where some interesting or important event is taking place.

The electric energy produced by the transformer action of the microphone is too small to properly impress itself upon the high-frequency wave which is to transport it through space; therefore the feeble electric currents that represent the low, audible frequencies of the sound must be amplified by what may be called a speech or voice amplifier.

The microphone and speech amplifier of a broadcast station are illustrated schematically in Figure 2.

After the speech amplifier has magnified or amplified the voice currents to the proper degree, they are caused to effect what is called a modulator; this serves to properly impress them on the radio wave which is to carry them through space. This radio wave is known as a "carrier wave."

The carrier wave may be of a frequency of from about 540,000 to 1,500,000 cycles (or complete vibrations) per second. These frequencies are designated as "high-frequencies" or "radio-fre-

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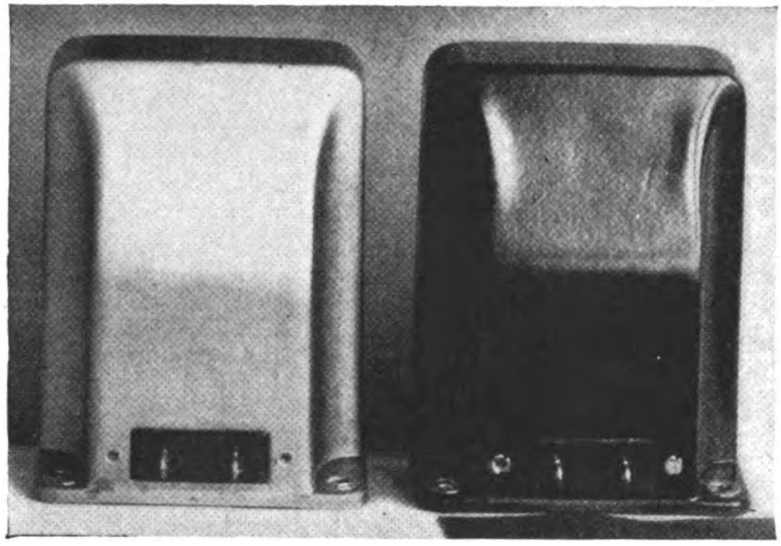


TWO TYPES OF COUPLING UNITS

FIGURE 1: *At the left is shown a high quality transformer, and, at the right, a double-impedance unit; both of these units are used to couple low-frequency amplifier tubes.*

quencies." Such frequencies are *inaudible*, as the normal ear responds only to frequencies lying between about 16 and 16,000 cycles per second. (The frequency of middle "C" on the piano is approximately 259 cycles per second). A high-frequency electric carrier wave is used, because, among other qualities, it is capable of being sent through space more readily than electric waves of lower frequencies.

The radio wave is generated by an electric oscillator; it is radiated into space by means of an antenna. When there are no sound waves to actuate the microphone, the carrier wave goes out into space without the power to actuate the ordinary receiving set in an audible fashion. However, when a sound wave encounters the microphone, an imprint of this wave is made upon the carrier wave so that, at a properly tuned receiving set, the response will be a *facsimile* of the original low-frequency disturbance at the transmitting microphone.

In the receiving set, the first problem usually is to amplify the feeble electric waves intercepted by the receiving antenna. To do this, it is first necessary to tune the receiver so that it is in a receptive condition for the carrier-frequency wave of the broadcast station whose program is to be received.

The high-frequency amplifier magnifies the currents produced in the antenna by these passing waves. These currents then actuate a detector or demodulator. The detector *undoes* what the modulator at the transmitting station did; that is, the detector extracts the low-frequency imprints from the high-frequency carrier wave.

The electric currents which the detector passes on to the succeeding apparatus represent feeble low-frequency electric waves which should be facsimiles of those produced by the microphone at the transmitting station. These currents in the detector circuit of the receiver may be of sufficient magnitude to operate a pair of telephone receivers or other sensitive reproducer placed in the detector circuit. In almost all practical cases a low-frequency amplifier is necessary at the receiver to give a receiving set sufficient power output to operate a cone or horn type reproducer.

It is remarkable that, in spite of the distortion introduced by every ailment of the transmitter and receiver, it is possible to obtain good reproduction with good apparatus. On the other hand, it is astonishing that with the possibility of obtaining good reproduction so few have taken advantage of the better low-frequency equipment. In most cases it will be found that the best is the cheapest, and in particular the most economical. In order to outline what is meant by the "best," let us consider first the electrical recording and reproduction of sound.

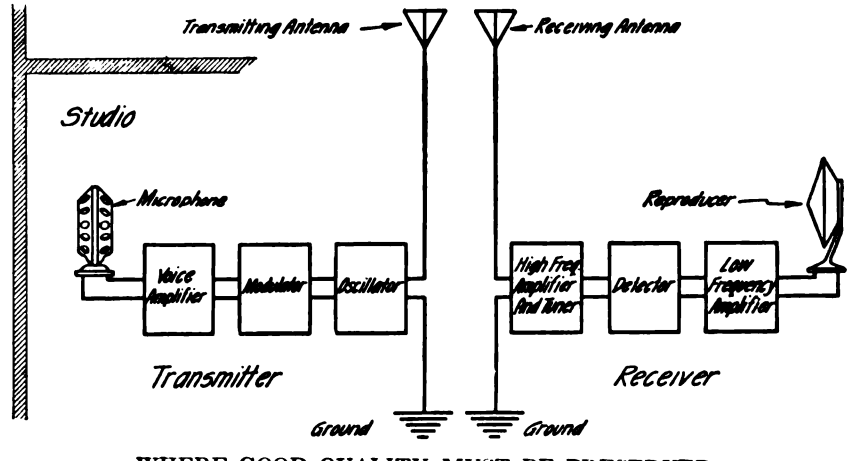
The microphone is a vicarious ear in which one has (but should not necessarily have), implicit faith. It "picks up" the audible or low-frequency disturbances about it and causes them to be converted into electric currents.

Before the "mike" can give you the best, it must have the best given to it. Therefore we must assume *a priori* that the speaker or artist has a good voice or is a good performer on his chosen musical instrument.

Further, the program must be rendered in the proper surroundings. The studio must be acoustically correct, so that there are no echoes, no objectionable reverberations, no objects or cavities to resonate to certain notes and, above all, no extraneous noises.

Distortion of the sound, then, may take place in the studio or wherever the program is "miked," and may not be entirely attributable to the transmitter or receiver. Assuming the proper kind of studio, the microphone will introduce some slight distortion, although in a properly designed and adjusted instrument it will not be noticeable except by delicate laboratory tests. Even though the "mike" has been properly adjusted, some distortion of the program is sure to occur in the voice amplifier at the transmitting station. In a good voice amplifier, this will not be noticeable, but there are many broadcasting stations with poor amplifiers or with good ones poorly adjusted.

With a good "mike" and a good voice amplifier, both properly adjusted, there is still a further possibility of distortion in the modulator. Too many broad-



WHERE GOOD QUALITY MUST BE PRESERVED

FIGURE 2: *To obtain undistorted reproduction at the loudspeaker of the sounds which enter the microphone, each unit of apparatus must pass along the current without distorting it in the slightest degree. This drawing shows, in a general way, the many different points at which distortion may occur.*

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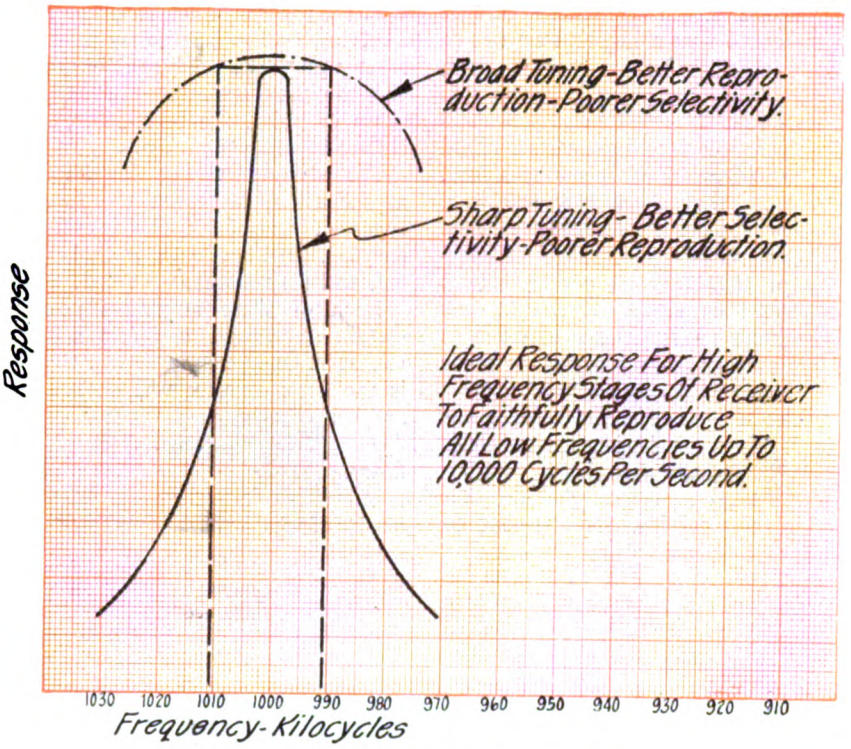
casting stations attempt to impress the low-frequency voice-current effects on the carrier wave too intensely, or to "over-modulate." This causes bad distortion of the louder sounds. The possibility of such distortion may be realized when it is stated that the average variation of power in speech is 1,000 to 1, and in music as great as 100,000 to 1. Even though the modulator is adjusted to give the best results, it may do poorly unless it has been carefully designed. There are consequently many broadcast stations which are not able to send out a well-modulated wave.

It must be realized that the thermionic valve (or as it is better known, the vacuum tube) which is used in the amplifier or modulator is not a perfect device, and that it will always introduce some distortion wherever used. In properly designed devices this distortion is so small that it is not discernible by the ear.

To sum up, then, the low-frequency waves must be faithfully transformed to low-frequency electric waves; and these, in turn, must be carried into space. The transmitter as a whole must be capable of responding to a whisper or a *pianissimo* passage, or to a shout such as a *fortissimo* passage. Not only this, but it must be impartial in its reproduction of different instruments. It must not introduce frequencies which are not present in the sound waves it has undertaken to translate into an appropriate form of electrical energy for broadcast transportation through space.

The transmitter, taken as a whole, may introduce "frequency distortion;" that is, it may not properly represent different frequencies of sound waves as to relative intensity, and it may introduce "harmonic distortion." That is, it may introduce frequencies which were not present in the sound waves actuating the microphone. Thus, before examining the receiving set, it is necessary to admit that the broadcasting station may be a flagrant offender. If it is not, and a good program is at hand, let us now examine the receiving set to find out how this good program may be reproduced with fidelity in all fairness to the creditable and deserving broadcasting station.


Broad Tuning-Better Reproduction-Poorer Selectivity.
Sharp Tuning-Better Selectivity-Poorer Reproduction.
Ideal Response For High Frequency Stages Of Receiver To Faithfully Reproduce All Low Frequencies Up To 10,000 Cycles Per Second.
Response
1030 1020 1010 1000 990 980 970 960 950 940 930 920 910
Frequency-Kilocycles

A STUDY OF RESONANCE CURVES

FIGURE 3: *The broadcasting curve gives a wide channel so that the side bands are included and no musical tones in the reproduction are lost. With extremely sharp tuning, the resonance curve shown in solid lines in the diagram cuts the side bands and the higher tones are lost, giving drummy or muffled reproduction. Ideal tuning is broad enough to cover the band from 1010 to 990 KC.*

The broadcast receiving set must first be tuned to the frequency of the wave of the station it is desired to receive.

This operation is not always properly performed. Some times the receiving set is so made that it never can be properly performed. A set which is exceedingly selective, or that gives a very high amplification with relatively few high-frequency stages, is almost certain to distort the currents which must actuate the detector and, thus, the reproduction.

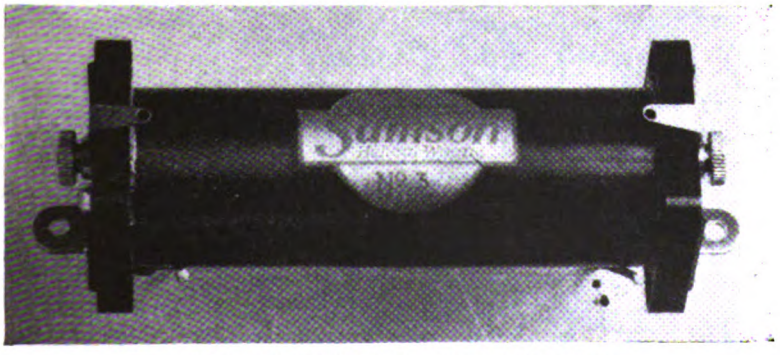
Selectivity, if too high, although often necessary to separate broadcast stations that are close together on adjacent wavelengths, introduces distortion by unduly attenuating or reducing the magnitude of the so-called "side bands" of the incoming radio wave. That is, the incoming radio wave consists of a spectrum of frequencies which range equally above and below the carrier frequency.

For instance:

If a broadcast station is said to have a frequency of 1,000 kilocycles (usually abbreviated "kc") or a wavelength of 300 meters (usually abbreviated by the greek letter λ) and if a receiving set is tuned to receive a wave of this frequency, this carrier wave will be present in the high-frequency amplifier of the set.

As the microphone is not being actuated, there will be nothing for the detector to strain out of the radio wave; no sound will be heard in the reproducer of the receiving set.

If, now, a pure tone of 1,000 cycles per second is allowed to affect the microphone, three frequencies will be radiated into space by the transmitting antenna. One will be 999,000, one 1,000,000 and one 1,001,000 cycles per second. The first and the last frequencies given are known as the "side bands";



ANOTHER TYPE OF COUPLING UNIT

FIGURE 4: *This photograph shows an impedance coil that may be used for coupling between two vacuum tubes that are amplifying at low frequencies. This type of unit is usually used with a coupling condenser.*

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the second frequency is the carrier. In the event that a higher tone (let us say of 4,000 cycles per second), were to effect the microphone, the two side bands would be 996,000 and 1,004,000 cycles per second, and the carrier would be 1,000,000 cycles per second as before.

In order that a set may receive a broadcast program consisting in part of musical notes having tones or overtones of 10,000 cycles per second, it must not tune so sharply that it does not respond to frequencies as much as 10,000 cycles (10 kc.) higher or lower than the carrier frequency.

Figure 3 illustrates the point made here; it brings out the fact that a broadly-tuned set will give better quality than a sharply-tuned one, and also that the broadly-tuned set is attended by poorer selectivity. With present day practice in the United States, where stations are supposed to be spaced 10 kc. apart, a selective set is a necessity. It is of advantage from the viewpoint of quality to be able to vary the selectivity so as to have a set most selective only when absolutely necessary. Such flexibility is possible, for example, in the "T—C." type of circuit using variable primary-coupling in a high-frequency transformer.

The detector, which translates the composite high-frequency wave into a composite low-frequency wave by finally eliminating the carrier wave, may introduce harmonic distortion or new frequencies not present in the original sounds. *At best* a detector tube distorts. If properly adjusted, the distortion which it introduces will not be detectable by ordinary means. It may, for example, introduce new frequencies if overloaded by the louder signals; in this case the louder sounds will be falsely represented.

It is wiser not to overload the detector with the idea of reducing the number of stages of low-frequency amplification in the receiver, as the detector tube will operate with a minimum of distortion only when it is not overloaded.

In order to obtain sufficient volume from a loudspeaker or reproducer, it is practically always necessary to have some form of low-frequency amplification in the receiver itself. Such an amplifier must faithfully magnify or amplify those electric impulses which are given to it by the detector unit.

In order that the low-frequency amplifier shall be able to do justice to the broadcast program, it must receive the proper undistorted impulses from the preceding units. The studio must be correct, the microphone faithful, the modulator good, the receiver tuning proper, and the detector functioning properly in order that an undistorted message may be passed on. Assuming that the low-frequency amplifier in the receiving set has been fairly treated, it is only proper to analyze it in order to give the last transforming device in the chain of units, the reproducer, a fair chance to do itself justice.

For the audible or low-frequency amplification, there are three general types of amplifiers: (1) transformer-coupled, (2) impedance or choke-coupled, and (3) resistance-coupled.

Each of these amplifiers possesses certain advantages and certain disadvantages. One person will vow that one is the best; another will declare that another of the three types is better. *Usually this declaration is based upon fancy.*

Many low-frequency amplifiers, no matter of what type, are operated under a handicap so that enthusiastic comparisons are often meaningless!

One of the uses of the ordinary three-electrode vacuum valve in receiving sets is that of an amplifier of electric energy. The amplification obtained by one valve may be too little, so that often several valves are used in tandem or cascade. A multi-stage or cascade amplifier is one of several valves arranged to that each one amplifies the energy given to it by the preceding valve. Thus the usual two-stage amplifier has two valves used as amplifiers, the three-stage amplifier three, and so on.

Some type of electric coupling must be used to connect the successive vacuum valves in an amplifier; it is the particular method of coupling and the quality of the coupling device which have much to do with the success of the amplifier and the quality of its output, or rather the quality of the sound given by the reproducer.

Figures 5, 6 and 7 represent the three methods of coupling two vacuum valves, and, therefore, the three general types of audio-amplifiers.

In the case of the low-frequency transformer coupling of Figure 3, there are two windings on an iron core. These two windings are insulated from each other; and they are connected to the vacuum valves as shown. When an electric disturbance of a changing nature (which may be designated as a changing voltage) is applied between the grid and filament terminals (marked G and F—) of valve number 1, a changing electric current results in the winding of the transformer known as the primary. The passage of a changing current through the primary winding of the transformer causes a changing voltage to appear between the terminals marked G and F— of valve number 2. If the transformer were perfect, the voltage would be the image of that voltage applied to G and F— of valve number 1.

In a well-designed low-frequency transformer it is possible to multiply voltages simply by constructing the device in such a way that there are more turns of wire in the secondary winding than in the primary winding in somewhat the same way that a lever may be used to multiply forces. It is this characteristic of a transformer which makes it very suitable as applied to a low-frequency amplifier. It is not only possible to obtain the (voltage) amplification of the valve itself in this way, but it is also possible to obtain even more (voltage) amplification by having a "turns-ratio" on the transformer greater than one (unity). For example, a transformer designated as a "turns ratio of 2 to 1" is one with twice as many turns on the secondary as on the primary.

The two devices of Figures 4 and 5 for coupling two vacuum valves do not have the same property of multiplying voltages possessed by the transformers of Figure 5. With the same valves it is impossible, then, to obtain as much amplification per stage in the cases of Figures 6 and 7, as it is in the case of Figure 5.

By the use of the so-called high "mu" tubes, however, this comparison is much more optimistic. Resistance-coupled and in some cases, choke-coil amplification is most effectively accomplished by the use of tubes having a high amplification factor ("mu"). With such tubes the amplification per stage approaches the value obtainable in transformer-coupled amplification.

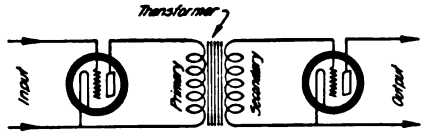

FIGURE 5: *This drawing shows the electrical connections for a single stage of transformer-coupled amplification.*

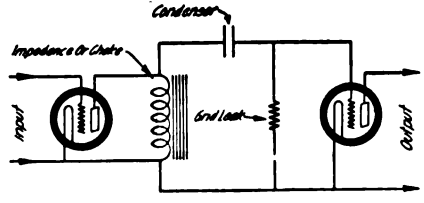

FIGURE 6: *The connections for a single stage of impedance-coupled low-frequency amplification are shown here.*

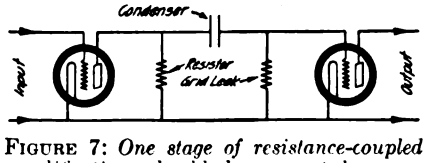

FIGURE 7: *One stage of resistance-coupled amplification should be connected up as this hook-up shows.*

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A REAL RADIO

"Interference Patrol"

How an emergency fleet of eight radio-equipped motor cars are employed for running down and suppressing unnecessary disturbances to radio reception.

By
JAMES MONTAGNES

Checking interference at its source—this time at the top of a telephone pole, where leakage from a power transformer has led to complaints from the fans in the neighborhood.

INTERFERENCE CAR NO. 3
Radio Branch, Department of Marine and Fisheries

SUCH is the legend on the doors of one of a fleet of eight automobiles equipped to run down radio inductive interference. These eight cars patrol the eastern part of Canada—and constitute a part of Canada's answer to the query raised by radio fans, "What can the Government do to check interference?"

Each car is specially built and furnished with the most sensitive radio receivers and two radio electricians.

Nearly two years ago, after a number of preliminary tests had proven successful, a staff of one engineer and three electricians were appointed to deal with radio interference from power line and electrical apparatus. An automobile was equipped with special instruments and sent on tour in Ontario and Quebec. In three months the two radio electricians with this car carried out investigations of interference in one hundred towns and villages. Two hundred and three cases of interference were handled, of which 124 were immediately eliminated; the majority of the others ceased to annoy broadcast listeners as a result of follow-up correspondence between the broadcast listeners, the owners of the electrical apparatus causing the interference and the Radio Branch at Ottawa.

Such has been the success of this section of the Radio Branch from the very first that the following year five cars were on continuous duty throughout Eastern Canada, with headquarters at Halifax, Montreal, Ottawa and Toronto. Three more cars have now been added to the fleet, one for Vancouver, another for Winnipeg and the third for London, Ontario.

An example of the work accomplished by one of these cars is the tour of car number 3 from June 3rd to August 13th, 1926.

Sixty-five municipalities in Ontario, from Ottawa to Galt, were visited; 286 cases of interference were investigated, out of which number 254 were due to faults on distributing systems. These may be summarized as follows:

Faulty transformer cut-outs numbered 234; other faulty series connections (including faults in disconnecting switches and terminals of transformers) were 8 in number; a similar number of cases were due to contact with ungrounded metal; 4 cases were due to lines being in contact with some high-resistance ground, such as wet poles and trees.

Each automobile is equipped with a superheterodyne receiver with direction-finding loop and volume control. Six and seven-tube superheterodynes are used, mounted in a special portable cabinet, which is connected by means of a multi-wire cable plug to a second cabinet that contains batteries and accessories; this receiver is sufficiently sensitive to record a noise due to a fault on a distributing system many miles away. In fact, it was used recently in two Ontario towns to locate faults on power lines situated in the one case fifteen miles and in the other four miles distant.

These receivers may be used while the automobile is traveling at a moderate rate of speed. The interference from the ignition system of the car usually pro-

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duces a sound in the receiver which is characteristically different from that produced by the power line, so that this type of interference, if not too great, is not objectionable.

In addition, a portable superheterodyne receiver is carried and used in special tests where two receivers are required. A portable three-tube regenerative receiver, complete with batteries and especially designed to be carried by one man, is also part of the equipment of the car. The latter set is used with a loop or various types of exploring coils for special investigation in power houses and places inaccessible to a car.

The tubes used in all these sets are the tiny "peanut" tubes, manufactured in Canada, which operate on dry cells.

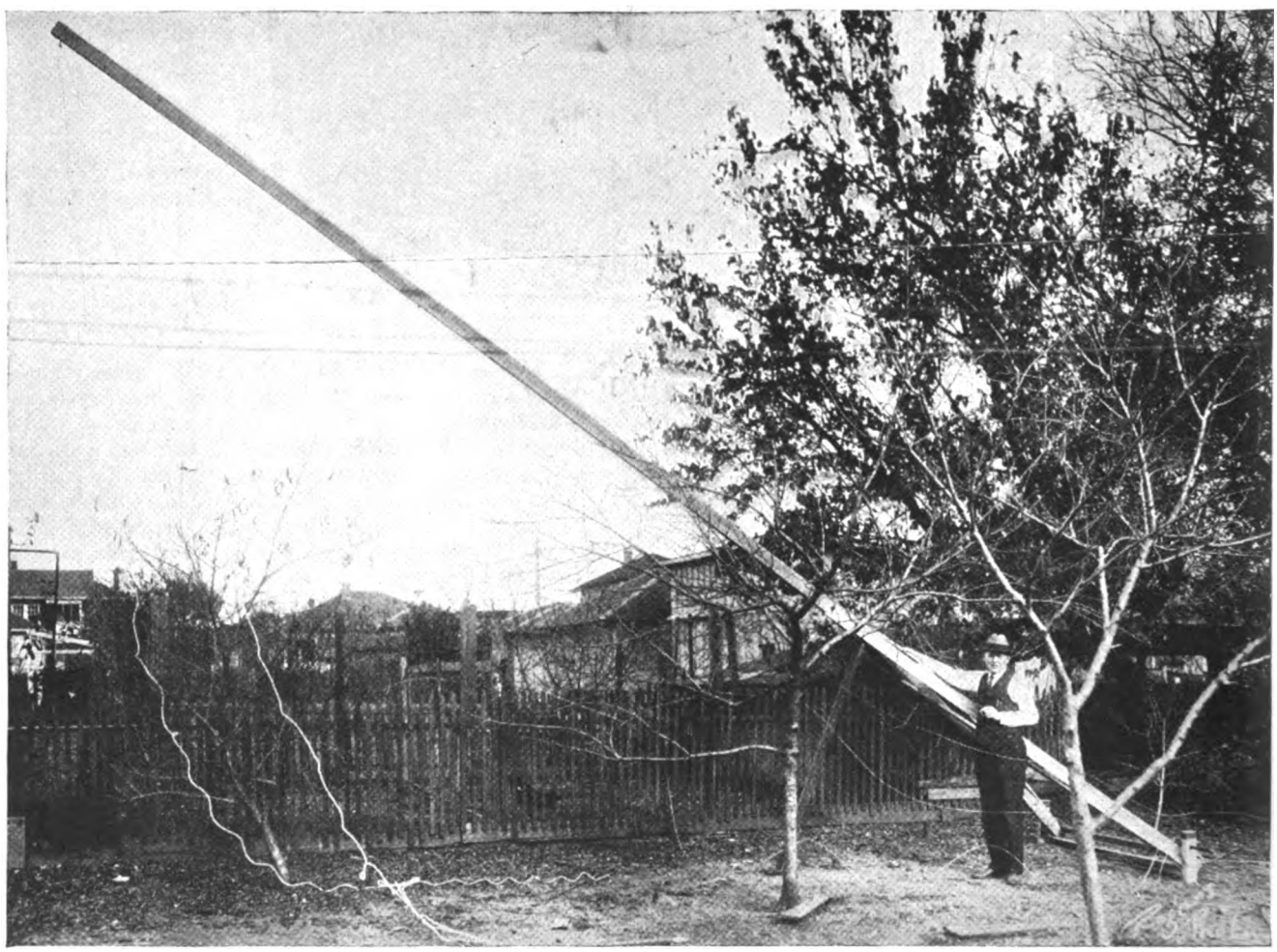
Many cases of urban interference are also handled; such, for example, as that originating in oil furnaces, electric signs, electrical heating pads, violet rays, and other electrical apparatus. In order to eliminate the interference after it has been located, a number of surge traps, made up of various sized choke coils and condensers, are to be found stored away in the upright cupboards of the cars.

Inside, each radio interference car resembles a cosy little room. There is a small bench at one side and a table across the back, under which is placed the superheterodyne receiver. Below this and surrounding it are a number of drawers and shelves that house other receivers, tools, measuring instruments, coils and many other items. On top of the table is the loop direction finding antenna, while a cupboard takes up some space behind the driver's seat.

That this service is provided in the Dominion may seem strange, but the listener in Canada is entitled to help in his reception of broadcast music. An annual license is required by every owner of a radio receiver; the charge is $1.00 for each fan. Out of this sum, amounting to over $125,000 during the year from April 1, 1925, to March 31, 1926, the radio interference cars with their trained staffs of two radio electricians are paid, and a number of other means of improving radio reception for the listener are made possible.

How to Build the *New* Browning-Drake Receiver—Told by Browning and Drake Themselves

¶ *In the next issue of* POPULAR RADIO*—for April—will appear an article on the new Browning-Drake standard receiver, in which the originators of this circuit will describe the improvements of the last year and will give complete constructional details for the new receiver, which will operate direct from the 110-volt, 60-cycle, alternating current lines.*



A. E. Burgess

AN ANTENNA MAST THAT CAN BE RAISED AND LOWERED BY ONE MAN

This thirty-foot mast was built by C. P. Burgess of Dallas, Texas of 2 by 4-inch timbers bolted together down to twelve feet from the lower end, where they are spread in a "Y" shape. The base consists of two substantial stakes that are driven into the ground, five feet apart. A one-inch iron pipe is then run through the stakes and the mast ends so that the mast may be easily raised or lowered by one person. Only a few guy wires are needed to finish off a rigid and efficient construction.

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From a photograph made for POPULAR RADIO

A CORNER OF THE LABORATORY WHERE THE TESTS ARE MADE

All of the apparatus that is listed in this Department has been tested and checked in the POPULAR RADIO *electrical testing laboratory, where the outstanding features and usages of new devices are determined and entered in the testing log book. From these records this Department is made up for the benefit of* POPULAR RADIO *readers. (The engineer, shown above, is obtaining the amplification factor of a vacuum tube.)*

What's New *in* Radio

Conducted by
THE TECHNICAL STAFF

Inventors, experimenters, manufacturers and readers generally are invited to keep POPULAR RADIO informed of all new apparatus that is of their own creation or that comes to their attention; if the apparatus passes the tests of the POPULAR RADIO LABORATORY it will be duly recorded in this Department.

A Device to Test the Voltage Your Power-pack Delivers

Name of instrument: "B" power tester.

Description: This instrument contains a milliammeter and a voltmeter which, when properly connected to the output of a power-pack, show the voltage the power-pack will deliver at any specified current drain. A rheostat is provided in the instrument to permit the current drain to be regulated as desired. Thus, if a power-pack is intended for use with a receiver which draws 25 milliamperes, the rheostat in the power tester is adjusted until the milliammeter shows a reading of 25 milliamperes. The voltage then shown by the voltmeter on the face of the tester is the voltage which will actually be delivered to the receiver. Terminals for connecting the instrument to the power-pack are provided at the top of the instrument. Also terminals by means of which the voltmeter and ammeter may be used separately for the measurement of any DC voltages or currents not exceeding 300 volts or 100 milliamperes. The voltmeter is of the high-resistance type (approximately 200 ohms per volt). The instrument is housed in a metal container with a crystalline finish. All terminals are clearly marked.

This instrument fills a long felt need inasmuch as the ordinary voltmeter will not provide reliable readings for this use because of the relatively low internal resistance of these measuring instruments.

Usage: To measure the output voltage of a "B" power-pack, at any desired rate of current drain.

Outstanding features: Enables the owner to tell just what voltage his power-pack is delivering to the receiver. Well made. Simple to use. Absolutely safe. Either meter may be used separately if desired.

Maker: Sterling Mfg. Co.

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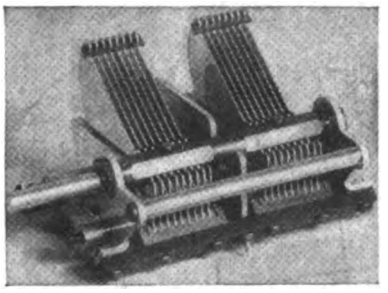
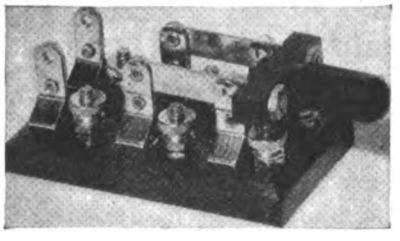


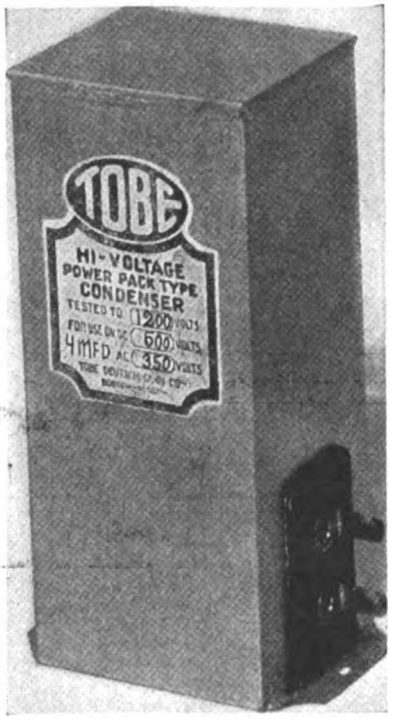
A Double Condenser that May be Used in the LC-27 Receiver

Name of instrument: Dual condenser.
Description: This double capacity unit, which is made especially for the LC-27 receiver, contains a grounded rotor section with a metallic shield between the two sets of stator plates. The shaft is made in one part with the two rotors fastened thereto by means of two set screws. The rotors are carried on a well insulated strip that is fastened at each end of the frame. The type of condenser plates used gives good separation of broadcast frequencies throughout the entire dial range.
Usage: As a tuning unit in radio-frequency circuits.
Outstanding features: Neat appearance. Efficient. Eliminates crowding on the dials. Easy to install.
Maker: Gardiner & Hepburn, Inc.



A Handy Double-pole Double-Throw Switch for the Radio Experimenter

Name of instrument: DPDT switch.
Description: This switch, which is exceptionally neatly made should be invaluable to the radio set-builder who builds his own testing equipment. It is well made of bakelite with nickel-plated brass switch blades and accessories. The switches are also made in SPDT, DPST and SPST styles.
Usage: In connection with changing circuit hook-ups in radio apparatus.
Outstanding features: Well insulated. Neatly made. Takes up small space. Positive connection.
Maker: Leslie F. Muter Co.



A High-Voltage Filter Condenser

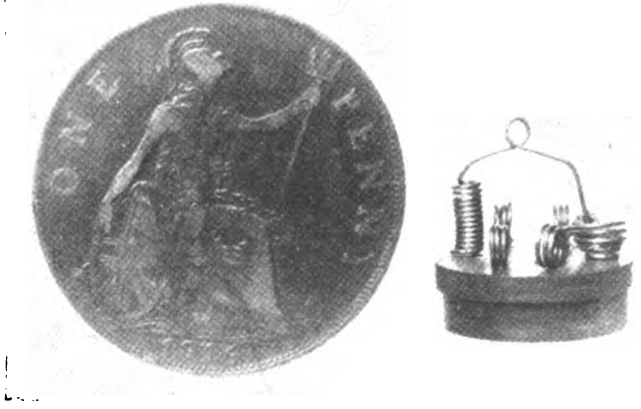
Name of instrument: Filter condenser.
Description: This capacity unit, which is enclosed in an aluminum can, is made in 2 and 4 mfd. sizes, and is rated at 500 volts on continuous direct current. It is equipped with a bakelite connection block with soldering lugs for connecting in the electrical circuit. It also contains two mounting legs that may be used for fastening the block to the base.
Usage: In a "B" power-pack as a filter condenser.
Outstanding features: Neat appearance. Takes up small panel space. Easy to connect. High-voltage operation.
Maker: Tobe Deutschmann Co.

A New Style Condenser that Helps in Tuning

Name of instrument: Variable condenser.
Description: The new Metralign variable condenser incorporates a type of plate that gives improved tuning characteristics to any receiver in which it is used. It combines the best features of straight-line-capacity tuning, straight-line-wavelength tuning and straight-line-frequency tuning and eliminates the shortcomings of each. The workmanship is exceptionally accurate and the condenser is constructed of such sturdy material and with such great care that it should last a lifetime.
Usage: In a radio-frequency circuit for tuning.
Outstanding features: Improved tuning characteristics. Easy adjustment. Noiseless operation. High efficiency.
Maker: General Instrument Corp.

A Loudspeaker That Looks Like a Book

Name of instrument: Cone-type reproducer.
Description: This loudspeaker which has the appearance of a beautiful book contains the Utah reproducing unit, the moving element of which is attached to the two top inscribed parchment pages of the book as it lies open and causes them to vibrate in much the same manner as the parchment cone of a cone loudspeaker. The unit is capable of great volume with very pleasing reception, reproducing both the high and low tones of music and speech; it is equipped with a long cord.
Usage: In connection with a broadcast receiver as a reproducer for home use.
Outstanding features: Novel idea. Beautiful appearance. Good volume and tone quality.
Maker: Utah Radio Products Co.



A RECEIVER HALF AS LARGE AS AN ENGLISH PENNY

This tiny crystal receiver is said to work as well as sets many times its size. A fixed tuning coil of fine wire is concealed in the base; the crystal is placed in the small wire cage at the right. The four tiny wire loops are for the antenna and ground connections and for the phone tips.

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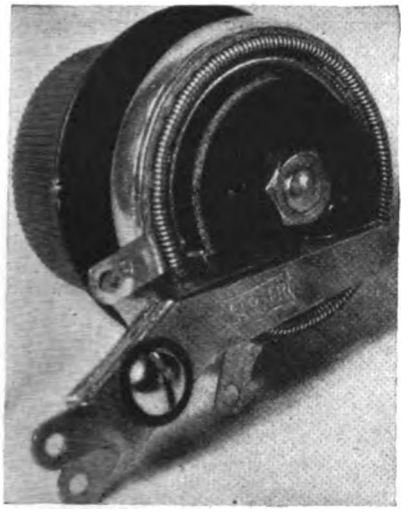
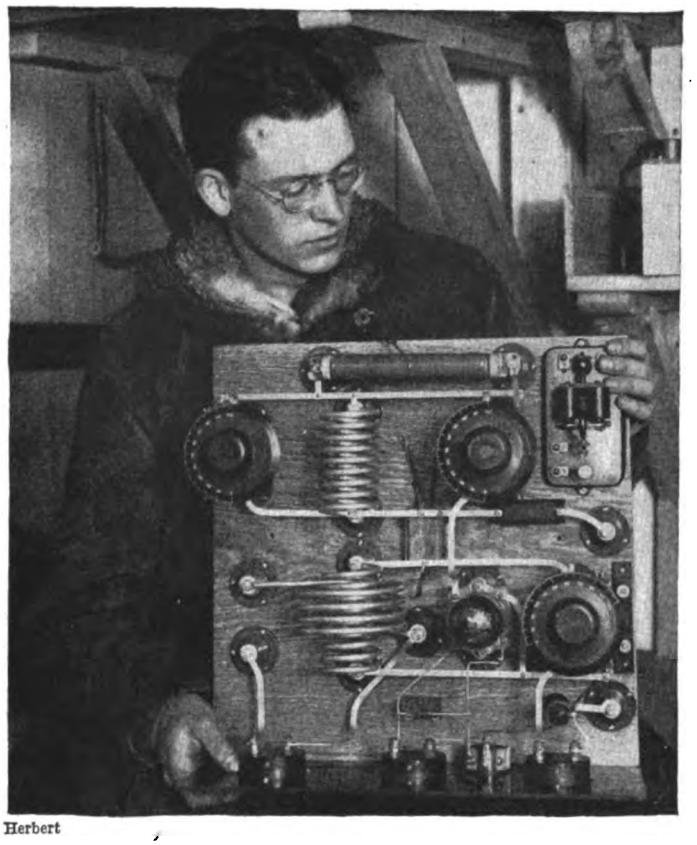
A High Current Variable Resistance for Regulating Power-pack Voltages

Name of instrument: Variable resistance.
Description: This new resistor, which is especially made for high-current work is exceptionally satisfactory for use as a voltage regulator in "B" power-packs. It contains much larger units than the standard Bradleyohm and will dissipate much greater power than the standard unit. It is built in strict accordance with good engineering practice and is equipped with two terminals which will accommodate the connecting wire either by a screw clip or by soldering. It may be attached to the panel by means of the single-hole mounting.
Usage: In radio circuits and especially in "B" power-packs for voltage regulation.
Outstanding features: High current carrying capacity. Rugged construction. Smooth variation. Neat appearance.
Maker: Allen-Bradley Co.



A Rheostat that Is Also a Battery Switch

Name of instrument: Combination switch and rheostat.
Description: This unit is similar to the regular Carter rheostat except that it has an additional part that functions as a switch as the rheostat is turned down. Upon revolving the rheostat in one direction, the resistance will be lowered in value and upon revolving the rheostat in the opposite direction, the resistance increases in value and finally a switch is operated that turns off all the tubes in the set. The rheostat, however, may be used on one or more tubes but it does not have to be used in series with the total number of tubes that are controlled by the switch.
Usage: As a filament control switch and rheostat.
Outstanding features: Compact. Efficient. Smooth operation. Saves cost of one instrument.
Maker: Carter Radio Co.



Herbert

A TRANSMITTING SET THAT IS "WIRED" WITH COPPER STRIPS

Wires have been almost completely eliminated in this neatly built seven-watt, short-wave transmitter by the use of copper tubing for the coils and copper strip for the connections between instruments. The set was constructed by two amateurs, Philip and H. A. Goetz (2CTF), for the schooner "Morrisey" for use during the Greenland expedition of the American Museum of Natural History. Note how the apparatus has been mounted upon insulators to reduce losses.

A Double-Impedance Coupler that Improves Audio Amplification

Name of instrument: Double impedance unit.
Description: This new unit, which is used for low-frequency amplification, contains a plate and grid impedance of the proper values and a suitable coupling capacity enclosed in a metal case with four binding posts mounted on insulating strips for connecting in the circuit. The two impedances have no magnetic coupling between them and the energy is supplied from the plate to the grid circuits of the two tubes used through the electrical connection afforded by the coupling capacity of the unit.

The unit gives exceptionally good amplification of both high and low notes and will handle large volumes without any noticeable effect from distortion due to overloading.
Usage: In a low-frequency amplifier as an interstage coupling unit.
Outstanding features: Good quality of reproduction. Great volume. Neatly made. Easily installed in a receiving set.
Maker: Ford Radio & Mica Corp.

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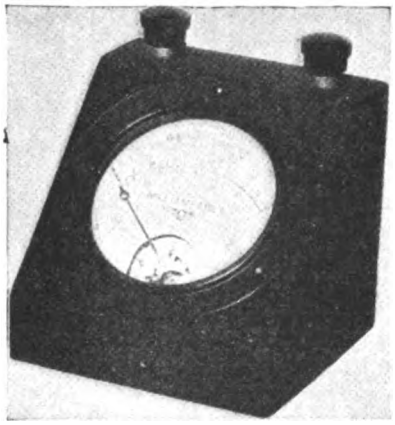


A Double Scale Galvanometer

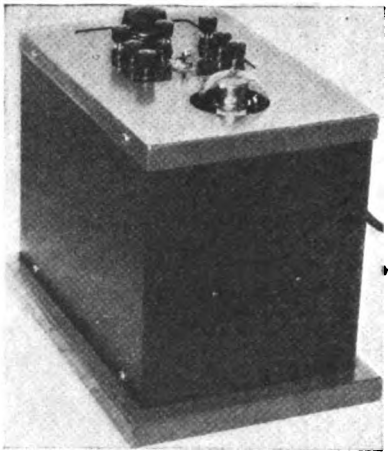
Name of Instrument; Radio-frequency milliammeter.

Description: This new measuring unit is equipped with a symmetrical scale for use as a galvanometer and with a calibrated scale for measuring milliamperes at radio frequencies. It is equipped for panel mounting or it may be used, as shown in the illustration, with the slanting metal base, for use in the laboratory. Two binding posts are furnished with the unit for connections to the external circuit. The case is finished in a neat crystalline black that is attractive and serviceable.

Usage: For use as a galvanometer or for measuring radio-frequency milliamperes.

Outstanding features: A compact laboratory instrument. Good accuracy. Good dial visibility. Large range.

Maker: Jewell Electrical Instrument Co.



A Well-made "B" Power-pack That Operates Efficiently and Quietly

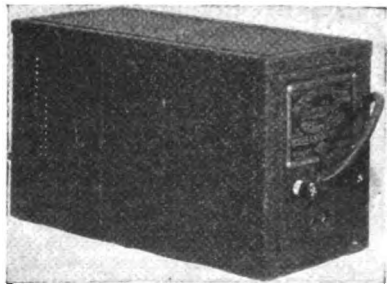
Name of instrument: "B" power-pack.

Description: This unit, which accommodates either the type B or type BH Raytheon, is a rectifier that furnishes direct current for use on the "B" circuits of sets and operates off the 110-volt, alternating current, lighting line. It is equipped with a number of taps for furnishing "B" voltages for the radio-frequency detector and audio-frequency amplifier circuits as well as a variable voltage where it is necessary. It is mounted and shielded in a neatly finished metal case with the terminals and switch located on an insulating panel at the top of the case. The case is easily removed for inspection. The unit is equipped with an extension cord and plug for connecting to the 110-volt, 60-cycle alternating current lines.

Usage: In connection with a broadcast receiver for supplying plate current to the vacuum tubes.

Outstanding features: Neat appearance. Silent operation. Suitable for use with any receiver. Efficient.

Maker: Chamberlain Electric Co.



A Device to Operate the Tube Filaments from the House Lighting Lines

Name of instrument: "A" battery eliminator.

Description: This device does away with the storage "A" battery completely and enables the owner to light the tube filaments of his receiver from the alternating current lines. It consists fundamentally of a 2-ampere charger which operates the filaments direct through a suitable filter. The device includes a relay switch which automatically turns on the alternating current power when the battery switch on the receiver is turned on. A receptacle is also provided in the case of this instrument to accommodate a plug from the "B" battery eliminator, thus permitting both to be controlled by the battery switch on the receiver.

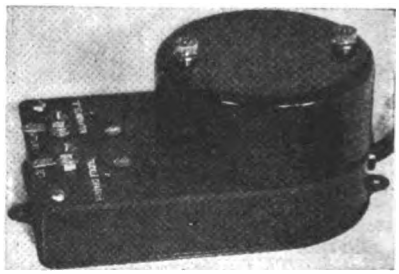
Usage: To supply the filament operating current for any receiver up to eight 201-a tubes or the equivalent.

Outstanding features: Well constructed. Good appearance. Automatically controlled. Supplies ample current to operate eight ¼-ampere tubes. No hum.

Maker: Briggs & Stratton Corp.

A CLOCK THAT TURNS YOUR SET ON AND OFF AUTOMATICALLY

To turn your receiver on or off at a specified moment. All you need to do is set the clock to the proper time by means of the knob just below the clock face; the clock alarm then makes or breaks the filament circuit at the set time. This apparatus is made by the Time-Lite Appliance Corp.



This Device Makes It Easy to Control an AC-Operated Set

Name of instrument: Automatic relay switch.

Description: This device is equipped with an extension cord and plug to connect it to the alternating current lines. The device also contains two receptacles to accommodate the plugs from the "B" power-pack and the trickle charger, which would ordinarily be plugged into the alternating current line direct. The instrument includes a relay which operates a

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double-pole, double-throw switch and is controlled by the filament switch on the panel of the receiver. When the filament switch is turned on, this instrument automatically connects the "B" power-pack to the alternating current line and disconnects the trickle charger. When the filament switch is thrown off, the "B" power-pack is disconnected and the trickle charger is connected.

Usage: To automatically control power-packs and battery chargers by means of the filament switch on the receiver panel.

Outstanding features: Completely enclosed to guard against accidental contact with the alternating current supply line. Sturdy construction. Eliminates the necessity of plugging the "B" power-pack and trickle charger in and out of the alternating current line and thus permits control of the "A" battery, the "B" eliminator and the trickle charger by means of the filament switch on the panel of the receiver.

Maker: Yaxley Mfg. Co.

A Handy Insulator

Name of instrument: Stand-off insulator.

Description: This is a glazed porcelain, pedestal insulator approximately 1½ inches high equipped with a binding post. The porcelain base is flanged and is equipped with screw holes for mounting the insulator.

Usage: This device serves the double purpose of insulating any wire which is attached to its binding post and at the same time keeping this wire at least 1½ inches away from the wall or other object upon which the insulator is mounted. It is especially useful in insulating long battery leads, antenna leads, etc.

Outstanding features: Extremely rugged construction. Provides practically perfect insulation. The binding post at the top provides an easy way of attaching the wire or instrument which is to be insulated.

Maker: General Radio Co.

An Instrument for Measuring the Voltage Output of Battery Eliminators

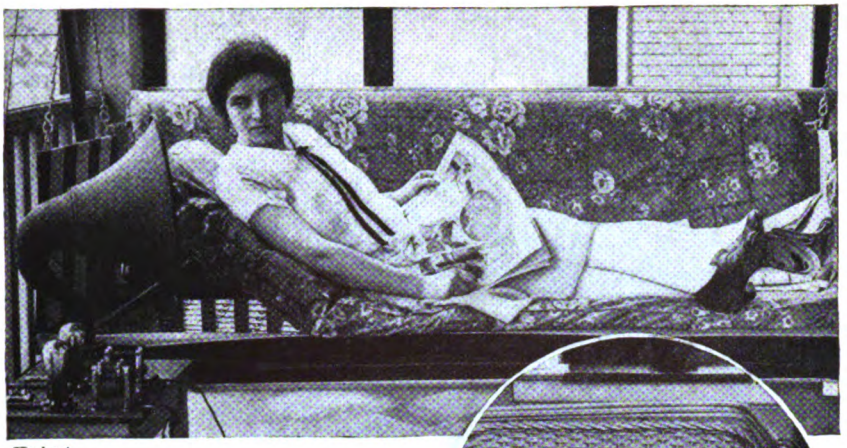
Name of instrument: Voltmeter and high resistance multiplier.

Description: This meter is of standard size, workmanship and material. It is supplied with an external resistor which results in a meter resistance of approximately 1000 ohms per volt and is therefore capable of accurately measuring voltages of high-resistance circuits, such as those of "B" power-packs.

Usage: For measuring the direct-current voltage of any high-resistance circuit. Especially useful in measuring the output voltages of "B" power-packs up to 600 volts.

Outstanding features: Convenient size and shape for mounting on a panel. Reliable construction. Accurate. Useful in conjunction with high resistance circuits which cannot be accurately measured by standard voltmeters.

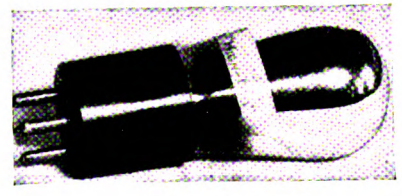
Maker: Weston Electrical Instrument Corporation.



Herbert

A RADIO SYSTEM THAT BROADCASTS BABY'S "S.O.S."

An unusual application of radio is this microphone attached to the side of the baby's crib; it brings his cries to an amplifier and loudspeaker placed in a distant part of the house. This ingenious system was designed for its tiny broadcaster by Frank Lester (2AMJ), a Richmond Hill, N. Y. "ham."



A Tube That Gives Higher Audio Amplification Per Stage

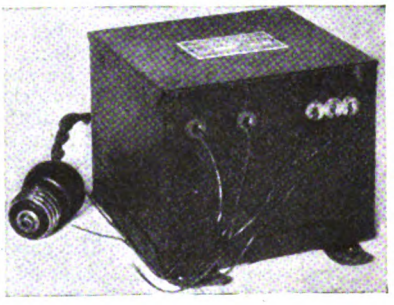
Name of instrument: High-mu vacuum tube.

Description: This is a tube especially designed for use in the intermediate stages of an audio-frequency amplifier. The amplification factor (*mu*) of this tube is approximately 20 as compared with an amplification factor of 8 for the average 201-a type tube. This tube, when used in the first audio stage, will provide increased volume on weak signals.

Usage: May be used as an amplifier tube in the intermediate low-frequency stages of a receiver and will sometimes find use as a radio-frequency amplifier tube or detector.

Outstanding features: Standard construction and equipped with standard base. Provides high amplification which increases volume.

Maker: C. E. Mfg. Co.



A New Unit that Simplifies Power-pack Construction

Name of instrument: Combination transformer and filter choke unit.

Description: This new device contains in a single metal can a power transformer for the Raytheon tube with a split secondary winding for full-wave rectification and two chokes that may be connected in the standard Raytheon filter circuit. The leads are brought out in suitable lengths on standard insulated wire that may be connected to the other instruments that will be incorporated in the power-pack. The unit is also furnished with an extension cord and a plug for connecting to the 110-volt, 60-cycle lighting lines.

Usage: In a "B" power-pack.

Outstanding features: Simplicity of design. Accommodates the new BH type Raytheon tube. Furnishes the proper values of inductance for the filter circuit. Easy to install. Compact.

Maker: Dongan Electric Mfg. Co.

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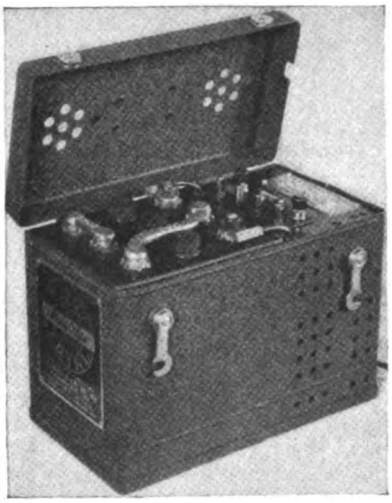


An Automatic "A" Battery Charger for Your Set

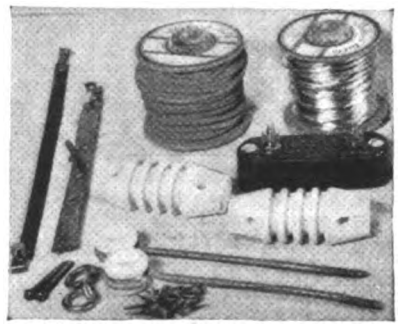
Name of instrument: Storage "A" battery with automatic trickle charger.

Description: This combination instrument is completely inclosed in a brown, crystalline finished, metal case which is perforated for ventilation, and which measures only 11 inches by 6 inches by 8½ inches. The unit consists of a 6-volt storage "A" battery, an automatic relay switch and a trickle charger. The device is so arranged that when the filament switch on the panel of the receiver is turned "on" the battery is connected to the filaments of the vacuum valves. When the switch in the receiver is thrown "off" the automatic relay in the battery unit connects the trickle charger to the battery and the battery is thus continuously charged at a slow rate while the receiver is not in use. The charger consists of a step-down transformer and a dry, electrolytic rectifier and also a regulating resistance by means of which the charging rate can be adjusted to any one of four rates of approximately .15, .25, .50 or .75 ampere per hour. A fuse is provided in the circuit to prevent damage in case the output terminals are accidentally short-circuited. The efficiency of the charging unit is extremely high and the operating cost of the charging device, even at the highest charging rate, is somewhat below 1/10 of a cent per hour.

Usage: As a continuous and dependable source for the filament-current supply for a radio receiver which uses standard 5-volt vacuum valves.

Outstanding features: Compact in size. Self-contained battery and charger. Automatic charging control. The charger uses a dry electrolytic rectifier and therefore requires absolutely no attention on the part of the user.

Maker: The Prest-O-Lite Co., Inc.



Complete Parts for That New Antenna

Name of instrument: Antenna kit.

Description: This kit includes everything needed for the installation of a first-class antenna. It includes stranded antenna wire, rubber covered wire for the lead-in and the ground connections, a lightning arrester, porcelain insulators for the antenna and porcelain stand-off insulators for the lead-in wire, a ground clamp for making the ground connection to a pipe or radiator, an insulated strip which is used to bring the lead-in wire through a window and the necessary screws and tacks.

Usage: For the erection of a complete outdoor antenna.

Outstanding features: Complete kit. All parts used are high grade.

Maker: Packard Electric Co.

A Double Cone-type Loudspeaker that Is Also a Ceiling Lamp

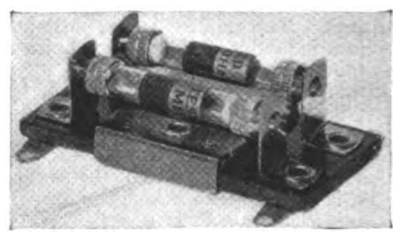
Name of instrument: Cone-type reproducer.

Description: This reproducer, which contains both a large and small cone made of translucent material, contains a reproducer unit that operates both of the cones or only the large one, as the user desires. It also contains a lamp fixture which may be connected to the lighting circuit. The light of the lamp shines through the colored cone and is reflected to the ceiling, giving a pleasant indirect light. The tone quality is exceptionally good.

Usage: In connection with a radio receiver as a reproducer of broadcasting.

Outstanding features: Novel design. Serves as a lamp and reproducer. Good quality. Capable of great volume.

Maker: Electravox Studios.



A Convenient Unit for the Resistance-Coupled Amplifier

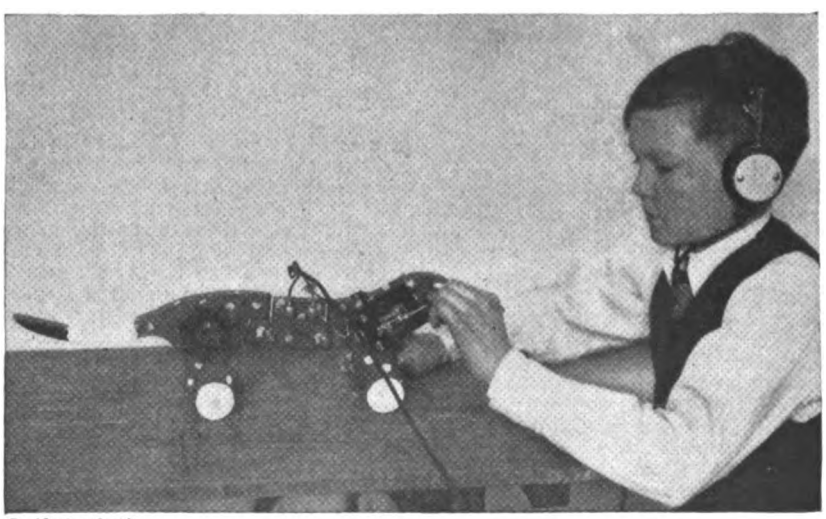
Name of instrument: Resistance coupling unit.

Description: This is a compact and simple unit which consists of a fixed, blocking condenser and two resistance units. The latter are mounted between spring clips and can easily be removed by simply slipping them out of their clips. The entire assembly is mounted on a base of composition material and convenient terminals are provided in the form of soldering lugs at the four corners of the base.

Usage: As a coupling device between vacuum valves in a resistance-coupled amplifier.

Outstanding features: Compact size. Easy to install. Easy to remove and replace resistances while experimenting to determine the proper resistance values for any particular part of a circuit.

Maker: Aerovox Wireless Corp.



Pacific & Atlantic

A "TALKING" DOG BUILT BY A TWELVE-YEAR-OLD FAN

A complete crystal radio receiving set is mounted along the backbone of this toy dog; it was built by George Frazee, a Los Angeles boy, from about $1.50 worth of apparatus.

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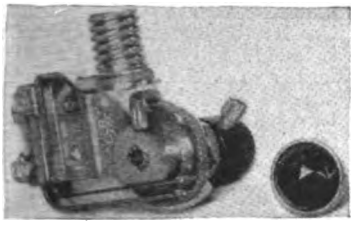


A Device That Prevents Waste of Battery Current

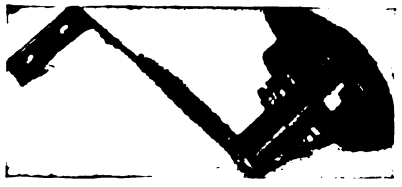
Name of instrument: Combined battery switch and pilot light for radio receivers.

Description: This device is a compact battery switch which, in addition to turning a receiver "on" and "off," also operates a pilot light which is mounted directly on the frame of the switch. It is mounted directly on the panel of the receiver by means of a single hole mounting and it is equipped with a small colored glass window which is intended for mounting on the panel directly in front of the pilot light. Thus, when the switch is turned "on" the pilot lamp lights up and gives visible indication, through the colored glass window, that the receiver is turned "on."

Usage: In a receiver for turning the receiver "on" and "off" and as an indicator as a safeguard against leaving the receiver turned on when it is not actually in use.

Outstanding features: Sturdy construction. Compact size. Easy to install. Positive in operation.

Maker: Yaxley Mfg. Co.



Lightning Protection in a Neat Form

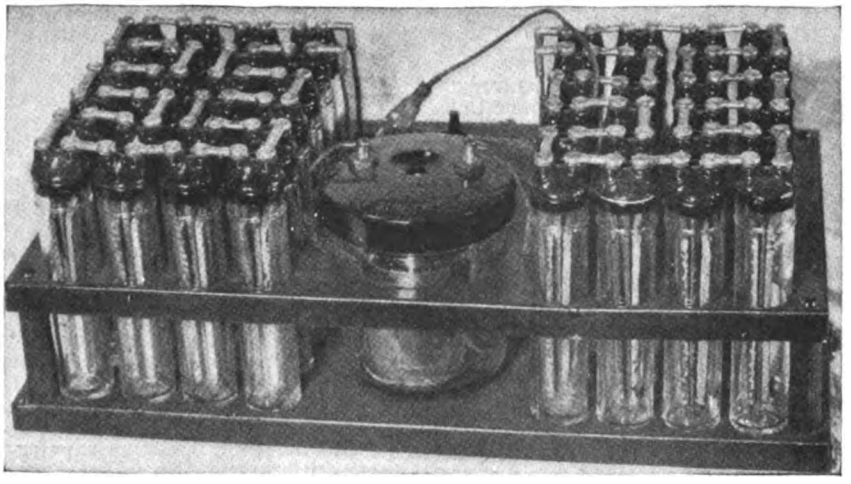
Name of instrument: Lightning arrester for radio installations.

Description: This arrester consists of a composition cap within which is located the protective device, and beneath which are the terminals for connecting the antenna and ground wires. The whole is mounted on a metal bracket for mounting the device outside of the window. This bracket also serves to keep the instrument well away from the wall of the house, in accordance with the requirements of the Board of Fire Underwriters. The projecting cap helps to protect the terminals from the weather, and the protective device itself is completely inclosed, and therefore fully protected.

Usage: To protect any radio receiver installation and its surroundings from possible damage due to heavy charges of static, or lightning.

Outstanding features: Nice appearance. Solidly constructed. Mounting bracket provides adequate spacing from building.

Maker: Swan-Haverstick, Inc.



This Unit Eliminates the "B" Battery Replacement Problem

Name of instrument: Storage "B" battery and charger.

Description: The battery consists of two banks of 24 cells each, and has a total average voltage of 96 volts. Each cell is inclosed in a cylindrical glass container with a porcelain top. The container measures approximately 1¼ inches by 6 inches. The capacity of the unit is approximately 2000 milliampere hours.

The cells are mounted in a metal rack with one group of cells at each end. In the center is an electrolytic charger, by means of which the entire battery may be charged at one time. A four-pole, double-throw switch is included in the unit, by means of which the two groups of cells may be connected in parallel for charging or connected in series for use with a receiver.

Usage: As the plate-voltage supply for a radio receiver, or for any other use where the current consumed does not exceed approximately 100 milliamperes.

Outstanding features: Compact arrangement. Well constructed. Easy to charge. Suitable for use with any receiver, especially with receivers which draw a high plate current. Battery and charger contained in a single unit.

Maker: Graynie Corp.

A Set With a Novel "Rejector" to Get Rid of Interfering Stations

Name of instrument: Bremer-Tully "Eight" Counterphase Receiver.

Usage: As a receiver for radio broadcast reception.

Outstanding features: Simplicity of operation. Good design and careful construction. Neat appearance. Specially designed to provide maximum selectivity through the use of a built-in rejector circuit. Good tone quality.

Description: In appearance the "Eight" is rather unusual, in that the panel that carries all of the tuning and adjustment controls occupies only a small portion of the front of the cabinet, and is entirely concealed when not in use. A small lower portion of the front of the cabinet is in the form of a drop door behind which this control panel is concealed.

Above this door, and in the center of the front, is a window, framed in bronze, through which the calibrated tuning scale may be seen. This scale makes use of an especially clever arrangement for indicating the wavelength to which the receiver is tuned.

The cabinet is of excellent material and workmanship and is finished in a deep brown shaded effect, lacquered and hand-rubbed.

The entire top of the cabinet is hinged to allow access to the receiver units. These units are all mounted on a strong, cast aluminum base, or

(*Continued on page 286*)

From a photograph made for POPULAR RADIO

A SEVEN-TUBE SET THAT IS TUNED BY A SINGLE CONTROL

An unusual feature of this receiver is the panel design; all of the controls are mounted on a strip near the bottom of the panel which is concealed behind a long, low door when the controls are not in use. The calibrated tuning scale may be seen at the center of the cabinet front.

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A Popular-Priced Power-Operated Receiver

Name of instrument: Amrad Neutrodyne Type AC-5 and Amrad Power Unit.

Usage: For radio broadcast reception.

Outstanding features: All operating current drawn from AC lighting lines. No batteries used. Good tone quality. Good appearance. Popularly priced. Easy to operate. Equipped with a power amplifier.

Description: This receiver outfit consists of two separate units: the receiver unit which is inclosed in an attractive wooden cabinet and the power-pack or power unit which is inclosed in a perforated metal case. A connecting cable is supplied to provide the connections between the two units.

The receiver, which is of the table-mounting type, presents an attractive appearance. The cabinet is a massive affair, not in size but in the construction and in the heavy material used. It is all of wood, including the front panel, and is finished in a two-tone mahogany, paneled effect. The top is hinged to provide access to the interior.

The front panel of the receiver carries all of the operating controls except the switch which turns the power "on and off." This switch is in the form of a pendant and is attached to the power unit by a five-foot cable.

The panel control consists of the three tuning knobs and a fourth knob which controls the amount of current to the vacuum valve (or tube) filaments. Immediately above each of the tuning controls is a small window through which is visible the calibrated scale that is operated by the the corresponding tuning control. The fact that there are three tuning controls does not make the process of tuning difficult because the settings of the three controls, for a given wavelength, are approximately alike. Then, too, a given broadcasting station will always come in at the same setting of each of the tuning controls.

Just above the filament control on the panel is a milliammeter which shows the amount of current being fed to the filaments of the UX-199 type valves. The power control knob is adjusted until the hand of this meter points to a section of the meter scale which is marked in red to indicate the proper operating point for the receiver. Once this adjustment has been made this control requires no further attention unless to make up for some variation in the line voltage itself.

There are no controls in the power-pack. All of its output voltages are permanently regulated to meet the requirements of the receiver before the unit leaves the factory. No attention to this factor is necessary on the part of the purchaser of the receiver, except one adjustment that must be made when the unit is first installed. The purpose of this is to accommodate the unit to the line voltage in the particular location where the receiver is put into operation.

Inside of the power-pack, on the case of the transformer, are two terminals marked "H" and "L." Between these two terminals a short length of wire is found, projecting from the transformer case. This wire terminates in a metal tip which fits either of these two terminals. When the outfit is first installed, this wire is connected to the terminal marked "L." If, when the receiver is put into operation, the meter hand cannot be brought up to the required point (60 milliamperes) on the scale, then the wire in the power unit should be disconnected from the "L" terminal and reconnected to the "H" terminal. It will then be found possible to obtain the proper reading on the meter scale, and the receiver will be ready for operation. Thereafter, this connection in the power-pack need never be changed.

The power-pack consists of a power transformer, rectifier and filter, all of which are completely inclosed in a metal case. The device is made foolproof by the inclusion of a cut-off switch which is automatically opened when the cover of the metal case is removed. Thus the power unit will operate only when the cover is on.

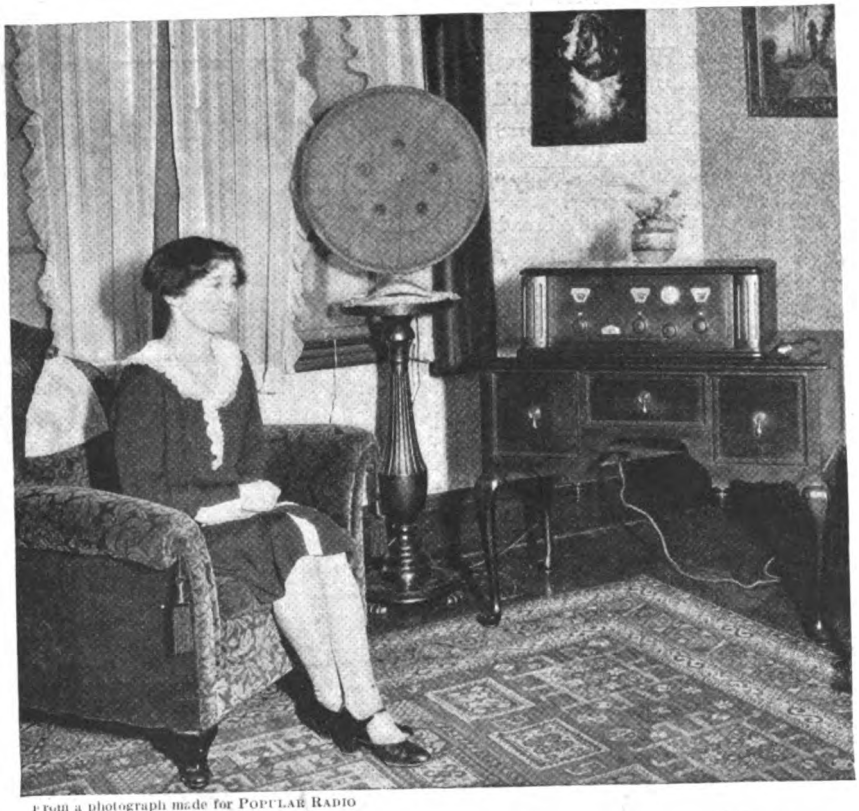
The design of the power-pack and the material used make this unit admirably suited to its purpose. There is no hum when the receiver is in operation and there is an extremely small chance for anything to go wrong in the power-pack. The filter condensers, which are usually the weakest link in a power-supply device, are of the electrolytic type and are designed with a considerable factor of safety.

The power transformer used in this unit supplies the high voltage, which then passes through the full-wave rectifier, which consists of two rectifier valves of the UX-216-B type and thence through the filter. The DC output from the filter then goes to the receiver through the controlling resistances which are incorporated in the power-pack. This direct current not only supplies the high-voltage requirements of the plate circuits of the receiver, but also provides the filament supply for the four UX-199 type valves. This arrangement is made possible by the fact that the filaments of these tubes are connected in series, and therefore require a total current of only 60 milliamperes. Alternating current is suitable for the filament supply for the UX-112 type power valve and this is supplied direct from a low-voltage winding on the power transformer.

The antenna should be erected outdoors if such an arrangement is at all possible. It should be between 50 and 75 feet in length, except in locations that are well isolated from broadcasting stations, where the antenna may be up to 100 feet in length. In city locations an antenna not exceeding 50 feet in length will provide the best selectivity.

The reproducer recommended by the manufacturer of this receiver is the Amrad "Cone Table" or the Crosley "Super Musicone." The audio amplifier of this receiver is especially designed for use with either of these reproducers and therefore gives better results with them than with most other kinds. In any case it is certain that the tone quality of this combination is very good.

Maker: The Amrad Corporation.



From a photograph made for POPULAR RADIO

A "NO BATTERY" RECEIVER AT A POPULAR PRICE

This receiver, which is of the table-mounting type, operates directly from the AC house lighting lines. The cabinet and the front panel are both of wood and are finished in a two-tone mahogany. Three tuning controls are used, but as the settings of all three are always approximately the same, tuning is not at all difficult; the fourth control regulates the filament current supply.

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IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

The Possibilities of Television

THE past winter has served to introduce one more technical term into the American mind, where now such erstwhile mysteries as atom and electron and wavelength possess, thanks to radio, their familiar chairs. The newcomer is television.

On December 15, Dr. E. F. W. Alexanderson, of the General Electric Company, presented before the St. Louis Section of the American Institute of Electrical Engineers, an address in which he summarized the state of the problem of television at that time.* Few scientific events of recent years have attracted so much popular attention or have been noted so widely.

Just two weeks after the Alexanderson address, Mr. J. L. Baird, of London, announced that he had perfected a new television device by which it was possible, not merely to see by radio or over a wire, but to see in the dark; the apparatus being operable by a so-called invisible ray which Mr. Baird had perfected.†

Virtually all processes of television or radio vision depend on the same fundamental principles. A thin pencil of light is caused to cross back and forth over the picture to be sent, as though each tiniest spot of the scene were made luminous in turn, all the rest of the scene being dark. Perhaps a better illustration is the beam of a searchlight picking out a landscape at night or the light-ray of a pocket flash light going over, bit by bit, the walls and contents of a darkened room. The television light pencil does not "see" the view all at once, as our eyes do; but in succession, one bit at a time.

This light ray, carrying successive bits of the view, is then converted, by a photoelectric cell or some similar device, into an electric signal. Like the light ray itself, this signal carries the scene to be transmitted; not all at once but bit by bit. It is as though the letters of this printed page were not visible all at the same time on the paper, but came along one after the other on a printed tape. At the receiving end the successive bits of the view which the electric message brings, whether by radio or over a wire, must be put together again on the flat, so that the view can be seen all at once in the manner which our eye requires.

There is no difficulty about this process except the difficulty of time. Many variants are already in use for transmitting photographs, diagrams or similar matter; where the light-pencil at the transmitting end can have plenty of time to trace out each element of the picture, transmit it and procure its equivalent tracing on the blank sheet of the receiver. But that is not television. In order that we should be able to see at the receiving end of the apparatus what looks like a natural view or like a moving picture, at least ten complete pictures must be traced each second. The standard motion picture presents sixteen successive pictures in each second. To decrease this number below ten or twelve a second produces an annoying flicker.

In his St. Louis address Dr. Alexanderson reviewed these facts and added one method in which the limitation of speed might be partially overcome. It was possible to use, he said, not merely one moving pencil of light but a number of them, each moving independently and simultaneously. In a model built by himself seven such light pencils are used. Thus each pencil needs to cover only one-seventh of the entire area of the

General Electric

HOW DISTORTION MAY AFFECT TELEVISION

Just as distortion in the receiver may make our ordinary broadcasts sound annoyingly untrue, so a similar distortion in Dr. Alexanderson's receiver for radio pictures produced this badly altered copy of an original drawing; released by Dr. Alexanderson, not as an example of success, but to show "how not to do it."

*Dr. Alexanderson's address was circulated in mimeograph form by the Publicity Department of the General Electric Company and was printed widely in newspapers on December 16, 1926.

†Mr. Baird's announcements were reported in cable dispatches from London on December 30, 1926. For an account of the Baird "televisor" see the article by Orrin E. Dunlap, Jr., in POPULAR RADIO for November, 1926, pages 649-650, 668, 670.

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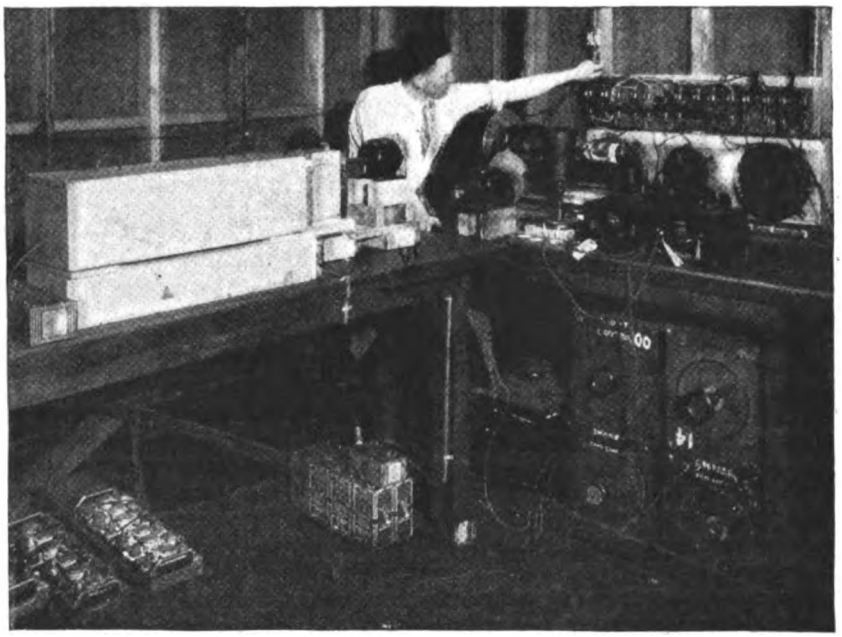

General Electric

WHERE THE PICTURES ARE SENT BY RADIO

This is the photo-radio transmitter used by Dr. Alexanderson to transmit pictures at speeds as great as one complete picture in two minutes. To attain real television, more than 600 complete pictures a minute would need to be sent and received.

picture. In use each light pencil of the receiver must be controlled separately by a similar light-perceiving apparatus at the transmitter; thus requiring seven ether-channels instead of one, radio being the medium of transmission. Even with the seven light pencils, the speed attained is far below that necessary for real television. Dr. Alexanderson has sent a picture in two minutes, whereas one in a tenth of a second is the goal which must be reached.

In the concluding paragraph of his address Dr. Alexanderson makes this statement: "Our work has already proven that the expectation of television is not unreasonable and that it may be accomplished with means that are in our possession at the present day."

Much as he hesitates to disagree with an engineer of the competence of Dr. Alexanderson, the Editor of this Department cannot bring himself to be quite so optimistic. It is true enough that television is not unreasonable. It is less certain that means at present known will be sufficient to bring it about. The seven light pencils of Dr. Alexanderson's apparatus are still far from fast enough and they have already introduced an enormous electrical and mechanical complexity, as well as an undue absorption of ether channels. Would it not be better to break new ground; to hunt for some totally new idea of how television might be accomplished, instead of attempting the enormous task of speeding up sufficiently the methods that are now in use for transmitting photographs.

The announcements of Mr. Baird, in London, are of much less interest and importance than the suggestions of Dr. Alexanderson. The essentials of the Baird method are like those of every other method. A mediocre result can be attained but there is no sign that improvements in speed will ever be sufficient to solve the practical problem of seeing over the ether or through a wire. The much-heralded "invisible ray" turns out to be nothing more than the well-known rays of infra-red light, used by Dr. Coblentz and General Ferrié, for signalling and already familiar to all physicists. ‡ Any television apparatus that will operate at all can be adjusted for the use of this ray instead of for ordinary visible light, but to talk of seeing in the dark with such a device is pure moonshine, and not visible moonshine either. The famous "secrets" which Mr. Baird is supposed to have imparted to the British Government anent this ray are probably common knowledge already in every physical laboratory.

‡See: "The 'Black Light' Radio," by S. R. Winters. POPULAR RADIO for December, 1924, pages 592-596.

The "Opaqueness" Theory of Radio

AN example of how a perfectly correct piece of observation may be misinterpreted to prove an impossible theory is furnished by the "shadow" or "opaqueness" theory of radio promulgated recently by Mr. A. J. Musselman of Chicago, Illinois, and which received considerable attention in the newspapers.

Just what the fundamentals of the theory are it is difficult to determine

(*Continued on page 270*)

International

A LIGHT BEAM THAT "CONFIRMED" A WRONG THEORY OF RADIO

When this powerful searchlight beam, at the Air Mail Field at Maywood, Illinois, was turned on between a radio transmitter and the receiver to which the waves were passing, the effect of the light in ionizing the air decreased the perfection of reception. This was mistakenly thought to prove the correctness of the "opaqueness" theory of radio.

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FEATURING THE NEW GENERAL RADIO DOUBLE IMPEDANCE

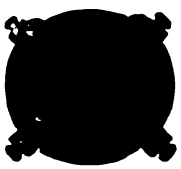
A NEW Amplifier Unit

which provides for FAITHFUL REPRODUCTION of FULL ORCHESTRATION

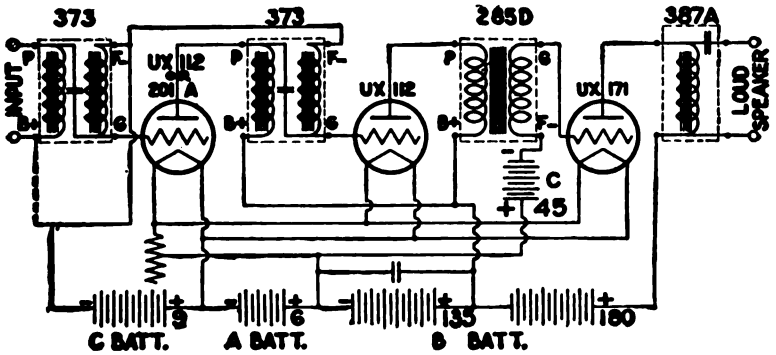
Type 373
Double
Impedance
Coupler
Price $6.50
(2 required)

Type 285-D
Audio
Transformer
Price $6.00
(1 required)

Type 387-A
Speaker
Filter
Price $6.00
(1 required)

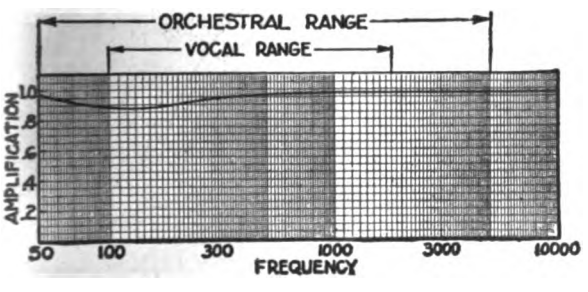


Type 349
Ux-Tube Socket
Price 50c
(3 required)



Type 410
Rheostat
6 ohms
Price $1.25
(1 required)

A Graphic representation of Vocal and Instrumental Tones as they are amplified by the Type 373 Double Impedance Coupler



The extent of its range of even amplification is from appreciably below 60 cycles to over 10,000 cycles, with a gradual downward deviation of slightly less than 7% between 100 and 400 cycles. This deviation in an otherwise perfect amplification curve is slight as to be practically negligible, because the ear of the average individual cannot detect a variation of intensity of much less than 25%.

The amplification curve, in fact, compares favorably with that generally obtained with resistance coupled systems which have the disadvantage of large sacrifices of plate voltages.

The above circuit diagram shows a combination of two stages of double impedance coupling and one stage of transformer coupling with speaker filter.

While the use of double impedance is not new in principle, the General Radio Type 373 Double Impedance Coupler is unique in design and performance. To facilitate installation, the complete unit, consisting of two impedances and a fixed condenser, is contained within a metal shell. It is connected in an audio amplifier circuit in precisely the same manner as a transformer. The amplifier combination shown above may be readily adapted to any standard manufactured or home constructed receiver and will produce a very noticeable improvement in tone quality.

Its high and even amplification extends over the range of FULL ORCHESTRATION. The deep bass tones of the tuba are brought out in full timbre as are the shrill notes of the piccolo. The range of the human voice is covered with pleasing clarity.

The above amplifier combination has the further advantage that it may be used with the General Radio Type 405 Raytheon Plate Supply Unit. By substituting two Type 373 Units for the transformers of a two stage transformer coupled amplifier the above combination may be completed and proper plate voltages provided by using the General Radio Type 400 Power Amplifier and Plate Supply.

Ask your dealer or write for Folder 373-P.
GENERAL RADIO CO. :: Cambridge, Mass.

GENERAL RADIO

PARTS and ACCESSORIES

The General Radio Company has endeavored to make it possible for the experimenter to obtain its products with minimum of effort. A careful selection of distributors and dealers has been made. They are best suited to serve you. If, however, you are unable to obtain our products in your particular locality, they will be delivered to you, post paid, direct from the factory upon receipt of list price.

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YAXLEY
APPROVED RADIO PRODUCTS

Automatic
Power Control

The Yaxley Automatic Power Control does all the extra switching for you. It takes care of your B eliminator or trickle charger or both. When you turn your set on, the trickle charger is off, the B eliminator is on. When you turn the set off, the Power Control is standing guard for you. It works automatically and without fail to turn off the B eliminator and turn on the trickle charger.

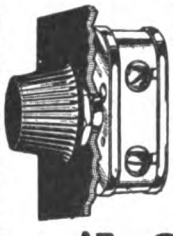
No. 444, Series Type—for use with sets with tubes having a current draw equal to or greater than 6 U.V.-199 type tubes. Each, **$5.00**

No. 445, Multiple Type—for use with any set and especially for sets having tubes with a current draw lower than that of 6 U.V.-199 type tubes. Each, **$6.00**

At your dealer's. If he cannot supply you send his name with your order to

YAXLEY MFG. CO.
Dept. P, 9 So. Clinton Street
Chicago, Ill.

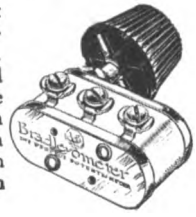
Bradleystat
PERFECT FILAMENT CONTROL



Provides complete noiseless filament control for all radio tubes without change of connections. Metal parts are nickel plated. One hole mounting. Self contained switch opens battery circuit when desired.

Allen-Bradley Co.
Electric Controlling Apparatus
276 Greenfield Avenue Milwaukee, Wis.

Bradleyometer
THE PERFECT POTENTIOMETER
Uses graphite disc resistors which are noiseless and not affected by atmospheric conditions. Metal parts are nickel plated. One hole mounting. Finish and knob match Bradleystat. Made in 200 and 400 ohm ratings.



Allen-Bradley Co.
Electric Controlling Apparatus
276 Greenfield Avenue Milwaukee, Wis.

In the World's Laboratories

(Continued from page 268)

but the proof offered for it is simple. At the Air Mail Field of the United States Government, at Maywood, Illinois, Radio Operator Arthur Frietag made tests of radio reception between a near-by transmitter and a receiving set. In the dark, reception was good. Then the beam of a powerful searchlight was turned on so that it traversed the space between the transmitter and the receiver. Reception was immediately less good. This was taken by Mr. Musselman, who was present, to prove that "opaqueness" (really merely darkness) is essential to good radio transmission.

The secret is, of course, simple. The beam of light from the searchlight had some effect, as all light has, in ionizing the air. The cloud of electrified air particles thus created in the space which the radio waves were traversing had disturbing effects on these waves; perhaps absorption effects so that the waves were weakened, possibly still other effects like bending or refraction. All this is quite well-known but seems to have escaped Mr. Musselman's attention. The beam of the searchlight merely did on a small scale what the light of the sun striking the earth does on a large scale. The experiment, however, is interesting and opens the way for further determinations.

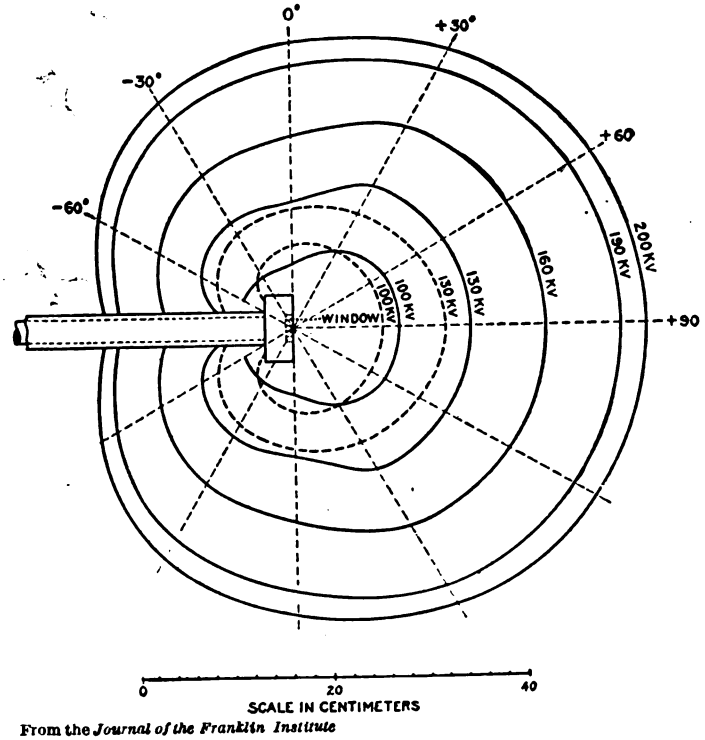
"Death Rays" and the Coolidge Tube

THE famous electron tube devised by Dr. W. D. Coolidge of the General Electric Company two years ago and much noted in the newspapers last fall when it was exhibited to the Franklin Institute, in Philadelphia, has now been described in detail and with some improvements in a paper by Dr. Coolidge in the *Journal* of that Institute.* Essentially, the tube is a device for getting electrons out into the air in a stream of what are really the so-called "cathode rays" well-known from the classic investigations of Crookes, Sir Joseph J. Thomson and others on such rays inside vacuum tubes.

When the filament of a radio vacuum tube is heated, electrons escape from it. They escape also from the filament of a hot electric lamp or from any other hot body in a vacuum. Dr. Coolidge invented, some years ago, the Coolidge X-ray tube in which the X rays are produced by a stream of electrons driven at enormous speed against a "target" of metal inside the tube. The electrons are

*"The Production of High-Voltage Cathode Rays Outside of the Generating Tube," by W. D. Coolidge. *Journal of the Franklin Institute* (Philadelphia, Pa.), volume 202, pages 693-721 (December, 1926). Also, "Some Experiments with High-Voltage Cathode Rays Outside of the Generating Tube," by W. D. Coolidge and C. N. Moore, the same, pages 722-735.

FIG. 12.



From the *Journal of the Franklin Institute*

A RANGE MAP FOR THE COOLIDGE TUBE

The electron tube perfected by Dr. W. D. Coolidge emits a stream of electrons through a window made of thin metal. Once out in the air, these electrons forsake their straight-line paths, being diverted by collisions with air atoms. The successive lines of this chart show the areas over which the emitted electrons spread at the tube voltages indicated.

I Will Train You At Home To Fill a Big Pay Radio Job

RADIO NEEDS TRAINED MEN!

If you're earning a penny less than $50 a week, clip coupon now. Send for AMAZING FREE BOOK, "Rich Rewards in Radio." Why go along at $25 or $35 or $45 a week, when many are now earning $50 to $250 in the same six days as a Radio Expert? Hundreds of N.R.I. trained men are doing it—why can't you?

TRAINED EXPERTS

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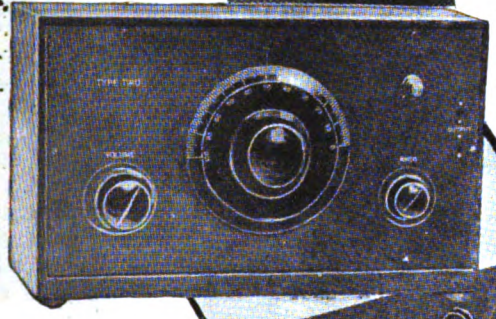
Radio needs trained men. Get into this new live-wire profession of quick success. It's the thoroughly trained man, who gets the big jobs of this profession—paying $75, $100, $200 a week and up. Hundreds of N. R. I. trained men are today holding down good, big jobs in the Radio field—men just like you—their only advantage is TRAINING. You can prepare just as they did, by new practical methods. Our tested clear training makes it easy for you. Big Free Book contains all the proof.

"I give you all this apparatus so you can learn quickly at home the Practical Way"
J. E. S.

FREE OF EXTRA COST



You Learn Quickly In Spare Time

So sure am I that I can train you successfully for a better future in this new Big-Pay profession, that I guarantee your training with a money-back bond. Lack of experience or education won't hold you back—common schooling all you need to start. You can stay home, hold your job, and learn quickly and pleasantly in your spare time. My practical, helpful methods make it possible for you to start RIGHT AWAY toward one of the bigger Radio jobs. Many men in Radio now earning $50 to $250 a week. No delay, no losing time from work—no scrimping or scraping to get your training.

Operates WMAQ

"Accepted a position with the Chicago Daily News Station WMAQ. MY INCOME PRACTICALLY DOUBLED, thanks to you. I handle all consultation, also do operating. Your course taught me not only the theoretical but also the practical knowledge that makes my work easy for me." Keith Kimball, Station WMAQ, Chicago, Ill.

You Get All of This

All instruments shown here and others sent to all my students free of extra cost under special offer. Clip coupon now—find out all about this big unequalled offer while you still have time to take advantage of it. This training is intensely practical—these instruments help you do the practical work. You learn workmanship and get added confidence in your ability.

$70 In One Day For T. M. Wilcox

"I am in business for myself and RECENTLY MADE $70 in ONE DAY. I was an electrician of rich experience, occupying a splendid position as telephone superintendent when I enrolled with you believing it would open up greater opportunities—have not been disappointed. Estimate Radio will be worth tens of thousands of dollars to me in next few years." T. M. Wilcox, Belle Island, Newfoundland.

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produced from a hot filament in the usual way and are formed into a speedy stream by the electrostatic attraction of a high-voltage electrode inside the tube. This is much the same as the action of the "B" battery voltage in drawing the electrons of a radio vacuum tube over to the plate.

This Coolidge X-ray tube was already a device for producing a stream of electrons, but this stream was in a vacuum. The new tube gets it out into the air. This was first accomplished over thirty years ago, before much was known about electrons, by the French physicist Lenard, to whom Dr. Coolidge makes due acknowledgment. A window of thin metal was inserted in one end of the glass tube. Against this a stream of electrons was directed. Some of them got through into the air but the attachment of the metal window to the glass leaked and the tube was otherwise unsatisfactory. Since that time the procedure of sealing metal to glass has been perfected, mainly by Dr. William G. Housekeeper of the Bell Telephone Laboratories. Making use of this newer knowledge and using a window of thin nickel or copper foil supported by a gridwork of heavier metallic molybdenum, Dr. Coolidge was able to produce a form of Lenard tube which would not leak air and which did discharge electrons.

The electrons escape through the metal window in the form of a conical beam of fast-moving electric particles. Some of these particles hit against the atoms of the metal foil through which they must pass and are deflected sidewise. Others hit against atoms of air and are similarly scattered. Accordingly, the thin beam of electrons which exists inside the tube becomes, when it escapes, a more or less diffuse cloud of these particles, more concentrated in the direction of the inner beam but spreading out to some extent in all directions.

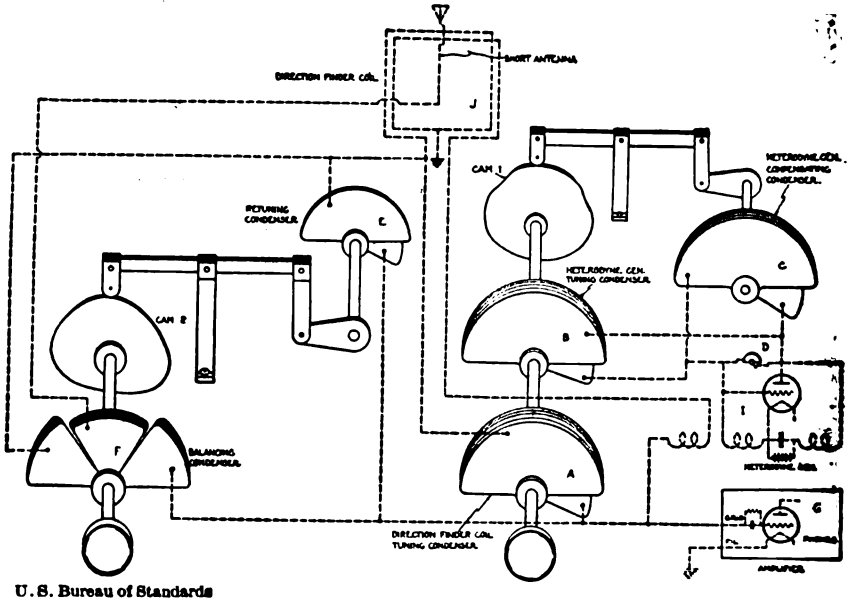
Many striking experiments have been demonstrated by Dr. Coolidge with this electron beam in air. It will act powerfully on chemical compounds, produce light in many minerals, destroy living matter, and so on. It has been compared to a more concentrated kind of radium but the comparison is not quite accurate, at least in so far as the curative action of radium is concerned.

A Small Portable Radio Compass

AN interesting development in radio direction finding is the small and portable radio compass recently perfected by Mr. F. W. Dunmore of the United States Bureau of Standards.* The entire apparatus is contained in a small aluminum box, which also serves as a shield against undesired radio energy. A vertical loop antenna may be turned around its vertical axis to obtain the directional readings.

The receiving circuit is a superheterodyne, as used in the standard receivers of the United States Signal Corps except that arrangements have been made to reduce the controls to two, one for tuning and one for balancing. A set of interchangable antenna coils is provided, together with a compensating coil for the heterodyne generator for each.

*"A Portable Direction Finder for 90 to 7700 Kilocycles," by F. W. Dunmore. United States Bureau of Standards, Scientific Paper Number 536 (part of volume 21), pages 409-430 (dated July 1, 1926; title page dated October 21, 1926, distributed December, 1926.)



U. S. Bureau of Standards

HOW THE PORTABLE RADIO COMPASS IS CONSTRUCTED

The components of the new portable radio compass recently designed by Mr. F. W. Dunmore of the United States Bureau of Standards, are shown in this diagram. A superheterodyne circuit is used. Tuning is extended to a wide range of wavelengths by the use of plug-in loop antenna coils, together with cams to operate the auxiliary condensers.

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Radio Measures the Earth's Waistline

THE world-wide tests of longitude by radio measurements planned in 1922 by an international committee of which the distinguished French radio engineer, General Gustav Ferrié, is chairman, were carried out successfully during October and November of last year. More than thirty nations participated in the tests. Practically all the astronomical observatories of the world made arrangements to tie their positions on the earth's surface into the remainder of the network. Reports indicating the successful receipt of the signals almost everywhere were made recently to the French Academy of Sciences* and to the American Astronomical Society, as well as to other participating scientific organizations.

The basic idea of the tests was the distribution of exact time, by radio, to each of the observing stations. By comparing this true time with the local time, as indicated by the sun, the exact longitude of each station can be determined. Ordinarily astronomers and surveyors use a chronometer for this time determination, adjusting the chronometer carefully at some standard meridian of longitude, like that of Washington or of Greenwich, and then carrying the chronometer to the station which is to be occupied. The difficulty is that the chronometer may change.

The method adopted for the recent tests was not the dependence on any one signal sent at a prearranged time, but the daily sending and reception of a series of signals transmitted at different hours and on different wavelengths. This was repeated for two months.

*"On a Great World-wide Operation for the Measurement of Longitudes" (In French), by M. Ch. Lallemand. *Comptes Rendus de l'Académie des Sciences* (Paris), volume 183, pages 765-768 (November 8, 1926).

Another Human "Aura" Claimed

Two Swiss investigators, Professor L. Farny and Dr. E. K. Müller, both of Zürich, have published recently some remarkable experiments which they claim prove the existence of some kind of emanation which escapes continually from the human body and which they call the "anthropoflux."*

A simple experiment is typical of all. A tiny condenser, made of two small plates of silver separated by a small air gap, is connected with an electrometer and a forty-volt battery and is placed near the skin, so that the supposed anthropoflux can pass between the plates of the condenser. This mysterious flux evidently decreases the insolating power of the air, for the charge gradually leaks across the condenser and is registered on the electrometer.

Assuming that the observations are correct, which is probable enough, one seeks for an explanation less startling than the assumption of some human emanation hitherto unknown; anything that would ionize the air in the condenser would serve. Possibly heat rays from the body would do this, but that is uncertain. It is conceivable, also, that activated atoms of one gas or another are escaping from the human skin continually, as a result of perspiration or of the small amount of respiration which the skin itself is known to carry on. Still other guesses are possible, none of them quite so unlikely as the one which the Swiss investigators appear to prefer. It is to be hoped that more experiments will be done and the matter cleared up.

*"A Flux Emanating from the Human Body which Renders the Air More Conducting and Increases the Dangers of High-Voltage Electricity" (In French), by L. Farny. *Bulletin no. 10 de l'Association Suisse des Électriciens*, Reviewed by "F. L. L." in *L'Industrie Électrique* (Paris), volume 35, pages 550-552 (December 10, 1926).

Underwood & Underwood

WHERE THE EARTH'S GIRTH WAS MEASURED

At this station, near San Diego, California, Captain F. B. Littell of the United States Naval Observatory took part in the world-wide plan of determining longitudes by radio, organized by General Ferrié of the French Army and recently completed.

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Static "Messages" from the Sun and Their Mythical Effect on Human Wars

ONE of the successes of the recent meetings of the American Association for the Advancement of Science, so far as publicity is concerned, was an incidental remark by Professor Michael I. Pupin, made at the end of his address as retiring President of the Association on the evening of December 27, 1926, in Philadelphia. Dr. Pupin had been discussing the history of the art of communication, as exemplified by the telephone and the radio telephone; he concluded by stating that he had discussed communications between persons on earth; he wished now to say a word about another kind of communication—that between the sun and the earth. Static and radio fading and other things which we now regard as annoyances were better regarded, he believed, as messages from the sun, messages which we might be able, one day, to read.*

This idea that terrestrial radio is affected by electric, magnetic or other disturbances in our familiar luminary is not a new one; indeed, the Editor of this Department had the honor to express a similar opinion in the very first issue of POPULAR RADIO, nearly five years ago.† Dr. Pupin's statement took hold, however, of the public fancy. Widely telegraphed by the press, it seems to have been interpreted by many editorial writers and others as indicating that Dr. Pupin had gone over to the side of the mystics and believed the sun to be inhabited by living creatures like ourselves, whose supposed "messages" to us were what he (Pupin) had in mind.

There can be no argument against the Doctor's real meaning, that sunspots and solar eruptions and other similar events are reflected on earth by radio disturbances which we ought to be able to read. That static is one of these disturbances due to direct action from the sun is unlikely; too much evidence now points to thunderstorms as the cause of most of the static, if not of all of it. Fading is more probably a direct solar phenomenon and there can be no doubt at all that the occasional periods of very low transmission—periods which the fans sometimes refer to as "blanketing"—are related to the magnetic disturbances created on earth by sunspots. All of this has been explained several times in the columns of POPULAR RADIO.

Modern astronomical discoveries make it certain that the sun is a great ball of white-hot gases; its surface temperature being in the neighborhood of ten thousand degrees Fahrenheit, and its central temperatures far higher, possibly as high as forty million degrees Fahrenheit. The upper layers of the sun, corresponding to the outer atmosphere of the earth, are composed of very thin gas, thinner even than the gas left inside the "vacuum" of a vacuum tube. This dilute gas is highly luminous because of the radiation which it receives from the lower layers, farther inside the sun. A part of this radiation is heat and light, other parts are composed of ultraviolet rays and of the still shorter X rays. The power house is deep within the sun's mass. There occur the atomic transformations which are now believed to provide the sun's energy. This energy, radiated layer by layer out to the solar surface, finally escapes into space in the form of the heat and light of which we receive our share.

So long as this process goes on in a perfectly orderly manner, the internal energy flowing uniformly to the surface and escaping uniformly into space, it probably would have no effect on the variations of terrestrial radio from hour to hour or day to day. But the solar machine does not work with perfect smoothness. We can see occasional great storms in the visible surface layers of the sun; these manifest themselves as what we call sunspots. Scientific study has shown them to be great whirling vortices, like terrestrial tornadoes but incomparably vaster, for some of them are large enough to swallow a dozen earths at one bite. We know that these sunspot vortices are the site of enormous magnetic forces. There is reason to believe that powerful streams of electrons shoot out from these vortices and that sometimes these electron streams strike the earth, producing the Northern Lights and other electric effects.

Sunspots wax and wane in frequency according to a cycle of about eleven years. The next maximum of the cycle is due during the coming winter. The increase of the spots began over a year ago, as has already been noted in this Department. At present we are in a period of high sunspot activity; which will continue, it is expected, for two years or more in the future. It is notorious that we have experienced during the past two years worse radio conditions than for the three years previous to 1925. Most radio engineers and astronomers join with Dr. Pupin in ascribing this misfortune to the disturbing effect of the sunspots.

There is no doubt, then, that the sun and radio are related. The question is, what can we learn about the sun by radio studies? It is doubtful whether we can learn as much as Dr. Pupin expects. The great problems of the solar students are chemical and physical problems. Whence comes the energy of the sun? Why do the sunspots occur in cycles of eleven years? Is matter being made or unmade in the sun's interior? What happens to the sunlight that streams away so bounteously from the sun as it does from billions of other stars in space? Radio studies on earth are not likely to contribute much to the solutions of these problems. More help may be expected from the spectroscope,

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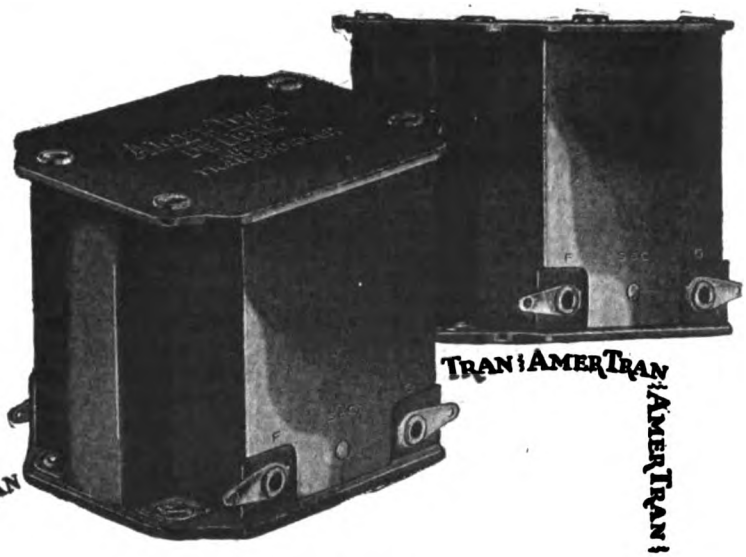

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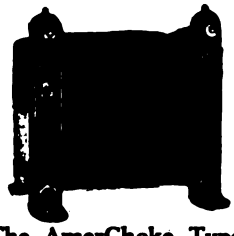

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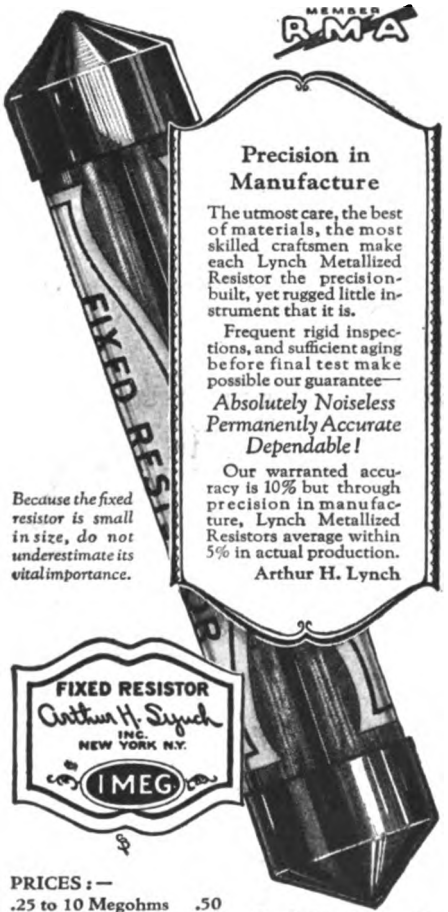

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an instrument which can determine the atom from which a light ray comes and the condition of that atom when the light ray left.

It is far more likely that the studies suggested by Dr. Pupin will prove valuable in reverse direction than that which he suggested. Anything that astronomers can learn about the forces and changes in the sun will be sure to help us to understand and to overcome such pests as fading and blanketing. It is not so sure that what we learn about radio will help the astronomers with their solar problems.

Another communication presented to the meetings of the Association which Dr. Pupin addressed was by Professor A. Tchijovsky, of the University of Moscow. It proposed the oft-repeated thesis that sunspots cause wars, an idea that is as old as the first recorded discovery of the sunspots by the ancient Chinese. Adopting the eleven-year cycle now generally accepted, Professor Tchijovsky attempts to show that the greater disturbances of humanity tend to cluster around the years when sunspots are visible in maximum number. The idea is by no means impossible, for recent researches at Mount Wilson Observatory, also recounted at the Association meetings by Dr. Seth J. Nicholson, prove that for the present period at least the percentage of ultraviolet rays in sunlight increases with the increase of sunspots. It is these ultraviolet rays which have the most pronounced effect in electrifying the upper levels of the earth's atmosphere and probably in causing the weakening of radio propagation which we are now experiencing. More important for Professor Tchijovsky's idea is the fact that ultraviolet rays have powerful effects on the human body, causing sunburn, stimulating the circulation, curing such diseases as rickets and even growing hair on bald heads. It is by no means impossible that the increase of ultraviolet rays in sunspot years might do something wide-spread to humanity and have some really noticable effect on human affairs.

But the proof of any theory is the way in which it fits the facts and by this test Professor Tchijovsky's sunspot theory of wars is found wanting. Only the most cursory examination of the data of history is necessary to show that wars or other disturbances do not follow any clear eleven-year cycle, which they would have to do if sunspots were their cause. To say, as some of the newspaper headlines did, that war will come in 1928 because sunspots will be plentiful in that year, is still farther from the actual truth.

*Dr. Pupin's address is published in full, but not quite as he spoke it, as "Fifty Years' Progress in Electrical Communications" by M. I. Pupin. *Science* (Lancaster, Pa.), volume 64, pages 631-638 (December 31, 1926).

†"Are We Getting Radio Signals from Another Planet?" by E. E. Free. POPULAR RADIO, volume 1, pages 8-13 (May, 1922).

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Radio in 1950 A. D.

(Continued from page 230)

The Federal government may at some time be obliged to take over or directly supervise all broadcasting of general public character—and we may then have three or four great stations blanketing the country with a national program on a high wavelength, while local stations keep to lower wavelengths, or *vice-versa*.

Meanwhile the mission of the radio Moses is to lead us out to a really high-standard of broadcast reception. The loudspeaker or reproducer cannot make up for deficiencies in receiving sets.

Indispensable as radio has come to be in our daily lives, the radio art is still in its infancy. (I will risk that bromide because it is so very true.) It is a lusty infant, to be sure, but infant diseases linger—especially the whooping cough. We have yet to subdue the whoops of the receiving set. The task of the radio technician is to really cure the infant of pulmonary disabilities. Modelled on the telephone receiver, the radio reproducer has from its beginning been built on the piston principle of operation by moving a diaphragm or cone in the direction perpendicular to its surface. There may be discovered better ways to do this in the near future.

One advance in the art of reception we are on the verge of attaining; indeed, it may possibly be an accomplished fact by the time this is printed—the use of one large audion or valve as equivalent to a group of smaller ones, with several steps of high frequency amplification in the same valve or tube. This will get us away from the growing multiplicity of valves which has resulted from our straining after better broadcast reception.

So many improvements are going forward that one hesitates to hazard a guess as to what receiving sets may be like a generation ahead; certainly there will be a still closer tie-up between wire-telephony and radio long before that.

When Mars was nearest the earth a few months ago an English doctor filed a radio message for that planet. His faith in radio was too great. But who shall say that some higher frequency may not make it possible to communicate with Martians—if there are any—when next their planet swings our way?

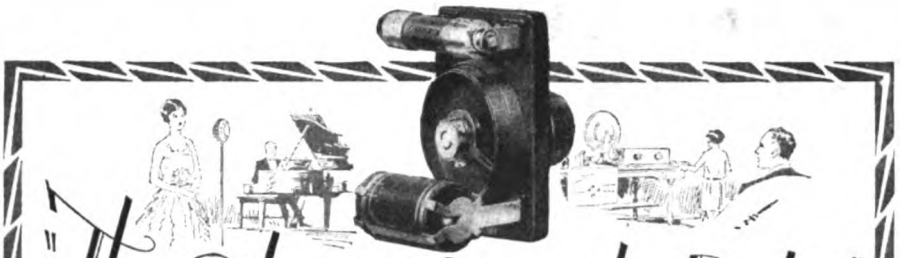
Attributed to radio competition, cable rates have been reduced for the first time in forty years.

* *

A music publisher alleges that broadcasting has the effect of shortening the life of a popular song.

We have all along been ready to believe that broadcasting would be found to serve some useful purpose.

—*Punch*



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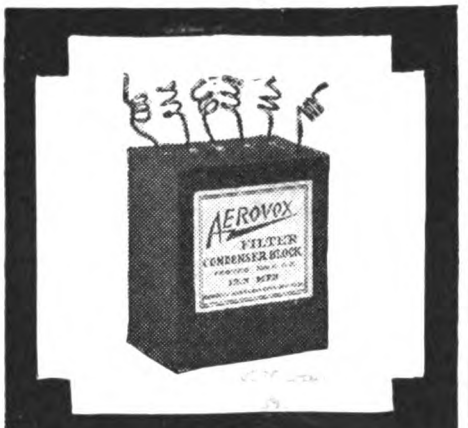


demand
AEROVOX
"Built Better"
FILTER CONDENSER BLOCKS
for all "B" Eliminators and Power Amplifiers
AEROVOX products are used as standard equipment by over 200 manufacturers of Radio Receivers and "B" Eliminators.

AEROVOX WIRELESS CORP.
60-72 Washington St., Brooklyn, N.Y.

NOTHING ELSE LIKE IT!

HERE is a simple radio control—*the Centralab Modu-Plug*—that is unique even in a field where phenomenal developments are common.

Provides smooth, noiseless control of tone and volume *direct at the plug* with the set operating at full efficiency. Without adjusting tuning dials or other controls, you can regulate volume from a whisper to maximum simply by turning the little knob on this plug. Reduces static interference—clarifies tone. Replaces the ordinary loud-speaker plug.

$2.50 at your dealer's, or mailed direct on receipt of price.

CENTRAL RADIO LABORATORIES
17 Keefe Ave., Milwaukee, Wisconsin
Manufacturers of variable resistances for all radio circuits

Centralab

ALCOA ALUMINUM

BOX SHIELDS

TO meet the growing demands of new radio design, which insist upon shielding, the Aluminum Company of America now provides a Box Type Shield.

Aluminum, used with success in the Alcoa Wing Type Shield (for interstage shielding) gives the set builder and the manufacturer an adaptable, easily-worked material of great durability and shielding performance combined with extreme lightness. Its uniformly high quality, judged from both metallurgical and radio standards, is established.

The New Alcoa Box Shield is especially designed to be of the greatest use to the greatest number of set builders. If it does not suit your size requirements exactly you will find that a few moments' easy work will adapt it most satisfactorily to your needs—being easily cut, easily worked and permanent when assembled.

Alcoa Aluminum Box Shields

are shipped knocked-down. Of heavy sheet, about the thickness of a half-dollar, (.080"—No. 12 B & S) to be completely effective for shielding.

Consists of: Top, Bottom, Sides
4 Extruded Corner-Posts
8 Aluminum Screws

Assembles 5" x 9" x 6".
Easily modified.

Ask your dealer, or write us

Some Other Radio Applications of Aluminum:-

Alcoa Shields, Box Shields, Cabinets, Panels, Variable Condensers, High-purity Rods, Foil for Fixed Condensers, Die-Castings, Screw Machine Products.

ALUMINUM COMPANY of AMERICA

2321 Oliver Building, Pittsburgh, Pa.

ALUMINUM

Popular Delusions About Radio

(*Continued from page 245*)

that height seems to be much less important than is commonly supposed.

The same observation applies to the widely-advertised theory that "the longer the antenna the better the reception."

Acting on this, many listeners have erected antennas as long as 150 or 200 feet, only to find that the result was broad tuning and excessive static. Most manufacturers now recommend an antenna of not more than 100 feet, and for all-around efficiency, in particular as regards sharp tuning and minimum static, as short as 50 to 75 feet.

Perhaps the most common and unfortunate delusion leads to the burning of the filaments of vacuum valves to their limit or higher. Thousands of listeners indulge in this practice; they are told that better results can be thus secured. But the only actual results are materially shortened filament life and inferior tone quality.

Valves are designed for maximum efficiency at a prescribed voltage, which can be determined by setting rheostats at the point recommended by manufacturers, or failing this by a few moments of experimenting. It will be found that considerably improved results on the score of tone quality, and practically the same volume can be secured by turning the rheostat slightly below the full position; at the same time securing much longer filament life, which is eminently desirable in itself.

Many manufacturers are now equipping their sets with automatic filament controls which make it impossible to burn the filaments too high. But with intelligent operation, this should not be necessary.

The most absurd though fortunately harmless delusion in connection with set operation, however, is that distant programs are somehow inherently better than local programs. Everyone has witnessed, if he has not been the principal in the spectacle of a listener clinging stoutly to a program from a station a thousand miles away, through static and fading, while one just as good, and probably much better, from another station a few miles away, capable of reception at full volume and *without interference*, goes to waste.

The explanation is, of course, the "distance" craze, plus lack of appreciation for the home town. Fortunately the first is passing, and rightly. And the delusion that distant programs are inherently better than home-town offerings is being slowly dispelled.

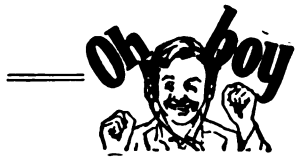
In fact, all of the delusions that encumber broadcasting in the popular mind are being replaced, one by one by something nearer the truth.

Flux a factor in Satisfactory Reception

THE importance of the proper flux for radio soldering, has become so significant, that manufacturers of better radio sets have, after extensive laboratory tests, adopted Kester Rosin Core Solder—alert set builders, too, use nothing but Kester Radio Solder, the handy size package of Kester Rosin Core Solder.

Pure rosin, as in Kester Radio Solder, is absolutely non-corrosive and is the only safe flux for radio. Being a hard, dense substance, rosin will not attract and collect dust (carbon particles) which forms a path for leakages. Chloride fluxes in either paste, liquid or compound form are highly corrosive. They absorb moisture from the air, and when heat is applied, a spattering, fuming and spreading action is caused. The areas over which flux is thus spread attract and collect dust (carbon particles) which forms an excellent path for leakages and soon impairs the receptive quality of any set.

Insist upon knowing that the set you buy has been soldered with Kester Rosin Core Solder and be equally sure that you use only Kester Radio Solder on the set you hook up yourself.



A free sample—write for it now

KESTER *Radio* SOLDER

The safe solder and flux for radio

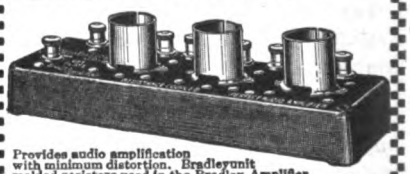
CHICAGO SOLDER COMPANY

4201 Wrightwood Ave.
Chicago, U. S. A.

Bradley-Amplifier

Resistance-Coupled

PERFECT AUDIO AMPLIFIER



Provides audio amplification with minimum distortion. Bradleyunit molded resistors used in the Bradley-Amplifier do not vary with age and are not affected by atmospheric conditions. Can be used to replace transformer amplifiers in standard radio sets with decided increase in tone quality.

Allen-Bradley Co.

Electric Controlling Apparatus

276 Greenfield Avenue Milwaukee, Wis.

Bradleyleak

THE PERFECT GRID LEAK

Provides a noiseless range of grid leak resistance from ¼ to 10 megohms. Assures most effective grid leak resistance value for *all* tubes. Small grid condenser (0.00025) is separate. Metal parts nickel plated. One hole mounting.

Allen-Bradley Co.

Electric Controlling Apparatus

276 Greenfield Avenue Milwaukee, Wis.

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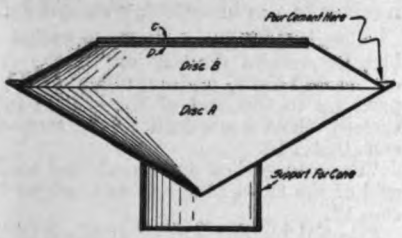
How to Build Your Own 36-Inch Cone Loudspeaker

(*Continued from page 250*)



HOW DISCS A AND B ARE JOINED

FIGURE 4: *Disc A should be inserted, front down, in a hollow cylinder such as a hatbox. Disc B should then be placed upon disc A and adjusted until the edges of the latter protrude an equal distance beyond disc B all the way around. Then pour the cement all around the edge of disc B where it touches the larger disc, A.*

Next, fasten the two small rubber washers onto the back rings as a bumper for the cone when hanging on the wall. A small eyelet should also be fastened in a proper position to hold the loudspeaker on the wall itself.

How to Adjust Unit E

Attach the cord to your radio receiver in the regular manner and loosen up the set screw in the side of the nose-piece and tune in a signal on the receiver. The signals at first will be either very weak or the reproducer will rattle. Adjust the unit, E, by turning the regulating screw at the tip either to the right or to the left until the proper volume is obtained without rattling.

Then, tighten the set screw and the reproducer is ready for continuous operation. When the cone is completed, the music and reproduction will be of a high order, giving the high and low tones that make for natural broadcast reception.

It should be remembered that the amplifier in the set should be a quality amplifier, if quality reproduction is to be expected. If the amplifier distorts, the signals from the cone reproducer will be distorted also, but if they are natural and lifelike, the resultant reproduction should be well-nigh perfect.

A Stolen Receiver "Squeals" on Its Robbers

A SQUEALING radio set that interfered with a Berlin policeman's enjoyment of his radio, recently led to the arrest of a band of robbers that had eluded the police for months. When the policeman found from a technical friend that his trouble in getting clear reception was probably due to an unlicensed and radiating set, he scoured the neighborhood to track the offender down. The result of his search was the discovery that a near-by apartment was being used as the storehouse of a gang of robbers and that among the loot was the radio that had been spoiling his programs.

Good tubes deserve AMPERITE

REG. U.S PAT OFF

The "SELF-ADJUSTING" *Rheostat*

ONLY Amperite can insure utmost clarity, volume and tone quality from your tubes. Only Amperite can safeguard them against damage and premature burn-outs through improper current regulation. There is only one Amperite—the patented, automatic, variable filament resistance. Don't be confused or misled into buying spurious imitations or substitutes represented to be just as good. All popular construction sets specify Amperite. Simplifies wiring. Eliminates hand rheostats. Price $1.10 complete.

Sold Everywhere

FREE—Send for "*The Radiall Book*" containing the latest popular hook-ups and construction data to Dept. P. R. 3

Radiall Company
50 FRANKLIN ST., NEW YORK

YOUR OWN BUSINESS Without Capital

Right now, there is an opportunity in your locality to profitably devote your spare time or all your time to a pleasant, easy and profitable business—one that does not require any training or capital.

The publishers of POPULAR RADIO offer you an opportunity to become their local representative to take care of expiring subscriptions and new subscriptions for POPULAR RADIO and two other popular magazines that they publish.

SALARY AND COMMISSION

All material will be furnished you free of charge and you will be paid an attractive commission and salary.

Mail coupon for full particulars.

POPULAR RADIO, Dept. 36,
627 W. 43rd St., New York City.

Send me full particulars regarding your salary and commission offer to local representatives.

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CARTER

"Midget" Rheostat with Filament Switch

Game trails and road builders

In the early days, most roads followed the old game trails, the early settlers used the easiest way. But the road builders made surveys — built bridges, cut tunnels, filled valleys. They built roads.

Half Size

$1
All Resistances

So in Radio, Carter has built parts — not just followed beaten paths, the way of least resistance —but built parts unknown in the early days of make-shifts. The result is there is no substitute for a Carter part.

Any dealer can show you why

In Canada: Carter Radio Co., Limited, Toronto

CARTER RADIO CO.
CHICAGO

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Copper Shielding

Gives better reception—closer selectivity and finer tone quality.

Sheet copper combines higher conductivity with easy working qualities.

COPPER & BRASS
RESEARCH ASSOCIATION
25 Broadway ~ New York

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INCORPORATED
219A Columbus Ave.
Boston, Mass., U. S. A.

Merchandising Radio Since 1919

DEALERS — send for large and profusely illustrated catalog on the products of scores of nationally advertised radio manufacturers.

Wholesale Exclusively

"Pioneers in the Distribution of Radio"

The Unique "Retrosonic" Receiver

(*Continued from page 248*)

rents find their way into the tuned loop circuit, 9 and 10, and are thus amplified at these frequencies across the plate and grid of the second tube. Finally, the low-frequency currents flowing through coil 9 are transferred over to the coil, 11, and thus to the grid of the third tube, through the low-frequency transformer, 15. It would appear, therefore, as if some form of reflex action does occur in the Retrosonic circuit, but it is not a reflex circuit of the usual type by any means.

The Importance of the Loop Circuit

The inventor of this new circuit attaches the greatest importance to the design and dimensions of the tuned loop circuit, 9 and 10, and to the coupling coil, 11. For the reception of broadcast signals on wavelengths lying between 100 and 600 meters he expressly states that the primary coil, 9, must have 64 turns of No. 24 wire and the secondary coil, 11, 89 turns of No. 28 wire, giving an inductance value of 389 microhenries.

These coils may be wound as plain solenoids, on formers 3½ inches in diameter, or, for convenience in coupling, may be plug-in coils mounted in a double-coil mounting. The same applies to the arrangement of the antenna inductance and its associated tickler coil. The tuning condenser, 10, in the tuned loop circuit should have a maximum capacity of not more than .0005 mfds.

It has already been remarked that the plate of the second tube has no "B" power connection. Another function of the hard-worked tuned loop circuit is, apparently, to take care of this anomaly, for the inventor states that, although there is no direct, high-voltage connection to the plate of the second tube, it is found in practice that a difference of potential will be set up between the plate and grid which is approximately equal to the voltage of the "B" battery.

This potential difference can actually be detected (when the set is in operation and receiving signals) by means of a suitable high-resistance voltmeter connected across the plate and grid of the second tube. There is therefore ample evidence of the building up of oscillatory currents of considerable magnitude in the tuned loop circuit.

To summarize the operation of the receiver in the inventor's own words:

"The incoming signals are applied at high frequencies directly on to the grid of the first tube, and simultaneously (in part) on to the grid of the second tube through the branch lead to the loop circuit, 9 and 10.

"From here they are transferred to the grid of the third tube and so back to the coil, 12.

"Partial rectification takes place in the first tube owing to the action of the grid battery, 8; and a similar operation takes place at the second tube owing to the presence of the grid cell, 8.

"Finally, any high-frequency energy reaching the grid of the third tube will be rectified by the action of the blocking condenser, 17."

Operation of the Receiver

It is, of course, somewhat difficult to convey to American readers an adequate idea of the capabilities of a British receiver, tested in England, but the following particulars may serve to give some idea of the performance of the Retrosonic receiver.

During a recent test, made in London within a short distance of station 2LO, the receiver proved itself capable of extremely gratifying results. Using an outdoor antenna, for which it is apparently best suited, the set brought in all the British stations, including relays, on a loudspeaker at will.

Even Cardiff, notoriously the most difficult station in England to receive, came in at good loudspeaker strength. No interference whatsoever was experienced from 2LO, which was broadcasting throughout the test. A large number of Continental stations were also tuned in, also free from interference from London, although the wavelengths of some of the Continentals were very close to London.

The test proved conclusively that, when working properly the Retrosonic receiver is capable of equalling the performance of a superheterodyne, and even bettering the performance of such a receiver as regards selectivity. Its range appears to be limited only by considerations of static and interference.

On the whole, this receiver is quite one of the most interesting developments in circuit novelties that has appeared for some time, and commends itself as being worthy of the serious attention of the amateur.

How to Build the New SC-II Receiver

So much interest was shown in the SC receiver, described in POPULAR RADIO *for March, 1926, that the designers have brought out a new and improved receiver on the same lines—the SC-II. This set is even more simple to build than the original SC although it is much improved in operation and quality and combines the newest developments in shielding and simplified control without increasing the over-all price. Watch for it—in* POPULAR RADIO *for April.*

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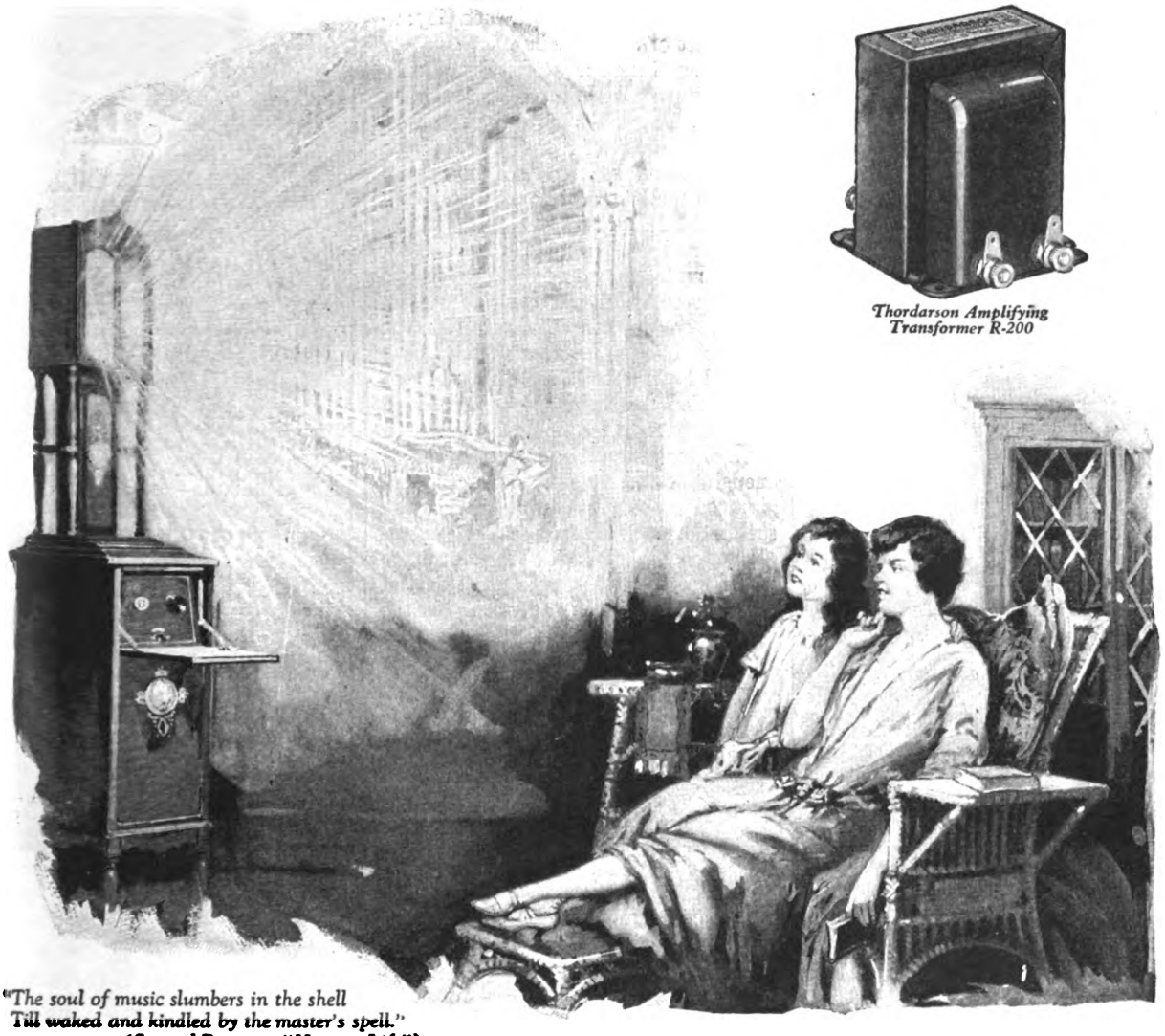
Thordarson Amplifying Transformer R-200



"The soul of music slumbers in the shell
Till waked and kindled by the master's spell."
(Samuel Rogers—"Human Life").

WITHIN your set slumbers a world of music which you can charm to a living fullness and richness of tone by installing Thordarson Amplification.

The manufacturers of leading quality receivers have recognized in Thordarson Amplifying Transformers a fidelity of musical reproduction which removes the ordinary artificial tones of radio and replaces them with living harmonies.

Whether you are buying a complete receiver, or whether you are building your own—if you enjoy music—be sure that your transformers are Thordarsons.

THORDARSON

RADIO TRANSFORMERS

Supreme in Musical Performance!

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Huron and Kingsbury Streets — Chicago, Ill. U.S.A.

(3550)

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TOBE

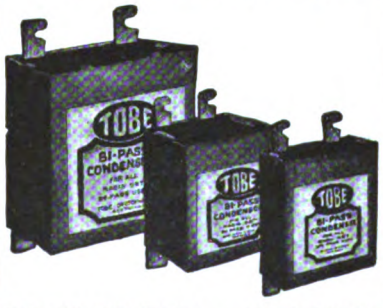
RADIO INTERFERENCE FILTER No. 1

is made for attachment to household motors and appliances, up to ¼ H.P., such as oil burners, refrigerators, sewing machines, vibrators, etc. Its design incorporates means for prevention of damage to commutators, which may occur when condensers only are used.

Provided with five leads so that no extra wiring is required for attachment. A simple wiring diagram is printed on the label.

Price—$15.00

Write for special descriptive pamphlet L-3



TOBE FILTER and BI-PASS CONDENSERS

Standard wherever Radio is found. They are specified by Arthur H. Lynch and James Millen in the National Lynch Power Amplifier. Radio Listeners Own Set—Shielded Highboy Super, Bruno Set, Samson De Luxe Set, Alden Somerbridge Circuit, Hi-Q-B-Eliminator, R. B. Lab. Set, Lincoln Super, Ultra-5. Used as standard equipment by National Company, General Radio Company, Philco, Modern, Storad, King Radio, and many other leading manufacturers.

Ask your dealer to show you the new TINYTOBE. A new process little condenser,—capacities .0001 to .02.

Tobe Deutschmann Co.

Engineers and Manufacturers

Cambridge :: :: Mass.

The "Radio Detective"

(*Continued from page 238*)

the skin-resistance test which is another part of the procedure.

But one of the characteristics of radio is that it will work invisibly and at a distance. Why not modify the standard electrical third degree of Dr. Link's demonstration so that it becomes an invisible and unconscious process, a "radio third degree"?

For the recording of the heart-beat, for example, it would be possible to place some kind of sensitive microphone, safely concealed, inside the structure of the imagined witness chair which I have already mentioned. Communication between this microphone and some recorder or loudspeaker in another room would be a problem simple enough for any experienced radio engineer. The only apparent difficulty in such a device is the fact that the microphone concealed inside the furniture would probably pick up a great deal of accidental noise in addition to the sounds of the heart-beat. If the witness moved in his chair, rubbing a woolen overcoat against the wood above the microphone, the recorder might indicate that the heart had exploded. There exist, however, so many modern methods of introducing audio-frequency filters to select certain sounds and to exclude others that a practical solution of listening thus to the heart-beat of an unsuspecting witness seems by no means an improbability.

Another point upon which the psychologists lay great stress in giving the electrical third degree is the exact timing of the interval which elapses between the asking of a question and the instant when the witness begins his reply. Hesitation is interpreted as suggesting, if not proving, some attempt to conceal the true answer to the question.

Since the timing of these hesitations must be so accurate that small fractions of a second are important, it cannot be done by ear alone or even by the use of ordinary stop-watch timers. In Dr. Link's demonstration the apparatus used was a special electric chronograph, so arranged that the timing mechanism was started by the breath of the examiner speaking the question word and was stopped by the breath of the witness speaking his reply. To pick up the necessary pulses of the breath thin metal diaphragms were placed close in front of the faces of the examiner and the witness. These diaphragms, pressed back by the breath pulses, made electric contacts and operated the chronograph. Here, obviously, is a job which radio could do better. A concealed microphone, placed conveniently anywhere, would operate a time-recording chronograph much more accurately and conveniently than any other known device.

Perhaps the best of all the electro-

RESULTS in easier tuning, more distance, volume and clarity—greater stability. Indorsed by leading authorities.

Indorsed by leading radio authorities

Model "N" A slight turn obtains correct tube oscillation on all tuned radio frequency circuits. Neutrodyne, Roberts two tube Browning-Drake, McMurdo Silver's Knockout, etc., capacity range ⅛ to 20-micro-micro farads. **Price $1.00**

Model "G" with grid clips obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in heterodyne and positive grid bias in all sets. Capacity range:

Model G-1—.00002 to .0001 MFD
Model G-5—.0001 to .0005 MFD
Model G-10—.0003 to .001 MFD
Price $1.50

X-L PUSH POST

Push it down with your thumb, insert wire, remove pressure and wire is firmly held. Releases instantly. **Price 15c.**

Push Post Panel permanently marked in white on black insulating panel. In box including soldering lugs, raising bushings and screws for mounting, etc. **Price $1.50**

X-L Radio Laboratories 2422 Lincoln Ave. CHICAGO, ILL.

Build the "Town and Country" Portable Receiver with Simplified Blue Prints

The "Town and Country" Portable Receiver, developed by the POPULAR RADIO LABORATORY and described in the July, 1926 issue, marks a decided advance in portable receiver design. While not a "vest pocket" receiver, the new "Town and Country" is small enough to be taken along on a motor boat or train trip. Efficiency has not been sacrificed for the sake of compactness.

The receiver uses six UX-199 tubes and one UX-120 power tube. Operating on a loop, tone quality is guaranteed by the use of a fundamentally correct circuit, high-class transformers and cone-type speaker.

The "Town and Country" Portable Receiver is mounted in a special mahogany cabinet with a drop front and is equipped with a carrying handle. All equipment, including the folding loop, cone loudspeaker, batteries and connecting cable, is installed in a suitcase. Connections from the equipment to the set are made by means of jacks and plugs.

By using POPULAR RADIO Blue Prints in building your "Town and Country" receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory model.

If your local dealer cannot supply you with Blue Prints of this set, they will be sent postpaid upon receipt of $1.00 per set.

POPULAR RADIO
Service Bureau 34-D
627 W. 43rd St., New York City

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psychological tests is the one called the psychogalvanic reflex. The method of conducting this test, devised by Dr. David Wechsler, of New York City, has already been described in POPULAR RADIO and is quite simple. Electrodes are attached to the skin of the witness. A small electric current is passed through the skin and through the witness's body, being measured by a delicate galvanometer. Any excitement felt by the witness is reflected within a few seconds by a decrease in the electrical resistance of the skin. As used by Dr. Link, this test was made visible through the movement of a spot of light on a screen. A decrease of skin resistance, indicating guilty knowledge on the part of the "criminal," was marked immediately by a violent motion of the light spot across the wall.

To give this test without the knowledge of the person who is receiving it seems difficult. The test is said not to work when alternating currents are used. To introduce the necessary direct currents into the skin requires large electrodes, tied firmly in place. No one could be fooled about the fact that these were being used.

However, I suspect that the possible applications of radio technique to this test have by no means been exhausted. Even if the production of a direct current through the skin of the subject is conceded to be beyond the present resources of our science, it is probable that the changes in the human skin, whatever they may be, which result from excitement and which make the reflex test a possibility, are accompanied by electrical or chemical disturbances which some radio method would be competent to detect.

If any radio engineer will take the trouble to devise and perfect some method of measuring this psychogalvanic reflex without the knowledge of the person who is receiving the third degree, he will find that his method, as well as the provision of invisible microphones for the heart-beat and for responses, will be heartily welcomed by the modern psychological detectives.

Radio Brings Country Boys Back to the Farm

To radio, more than to any other one thing, should be given the credit for checking the widespread and alarming migration of farm boys to the city according to Harold C. Lewis, a Chicago educator who has just completed a survey of the aims of the 2500 country boys who are in his student body this year. Mr. Lewis's survey shows that 75 percent of these boys plan to return to the farm upon graduation—25 percent more than in the survey of five years ago—and he credits this change largely to the fact that radio has made farm life far more attractive.

Add the new

Balkite Combination

to your radio set now

with your "A" battery it supplies all radio power automatically from the light socket

Now you can make your radio set a light socket receiver merely by adding the new Balkite Combination Radio Power Unit. Once connected to your "A" battery and set and plugged into the light socket, *it supplies automatic power to both circuits.* You need not even turn it off and on, for it is controlled by the filament switch already on your set and is entirely automatic in operation. It will give you a constant quality of reception that cannot be secured in any other way.

Balkite Combination can be installed in a few minutes. It has no tubes, nothing to replace or renew and is a permanent piece of equipment. It is noiseless in operation. It will serve any set now using either 4 or 6-volt "A" batteries and requiring up to 30 milliamperes at 135 volts of "B" current—any set of 8 tubes or less, including power tubes.

Add Balkite Combination now and know the pleasure of owning a receiver always ready to operate at full power not only for this season but for years to come. Price $59.50. [In Canada $83.] Ask your dealer. *Fansteel Products Company, Inc., North Chicago, Illinois.*

FANSTEEL

Balkite

Radio Power Units

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What Built the Reputation of

Mayolian
"B" SUPPLY

The "B" Without a Buzz

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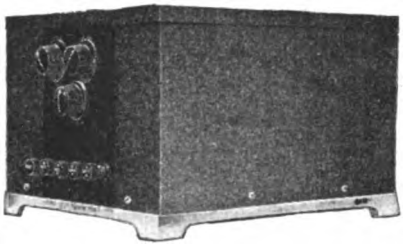


Type 612
Delivers 40 Mils at 180 volts
All voltages are adjustable
Complete with Raytheon Tube $42.50

PIONEERING in battery elimination, Mayolian was probably the first manufacturer to adopt the now far-famed Raytheon tube as the heart of its B Supply Units, and to earn the approval of Raytheon. From that day to this, each Mayolian has been rigidly held to the standards of the Raytheon and Mayolian laboratories. Years of exhaustive research, extreme precision in manufacture, skilled supervision—all these have contributed to the pre-eminent position of Mayolian.

Today, no matter what make or type of receiver you have, there is a Mayolian to give it a continuous, uniform, noiseless "B" Supply—direct from the nearest light socket, at half the cost of burning a 25-watt lamp.

The Heavy Duty Types of Mayolian employ the new Raytheon B H tube

The nearest dealer will gladly demonstrate in your own home. Write us.

MAYOLIAN RADIO CORPORATION
1668 Webster Ave., New York, N.Y.

Pioneers in Battery Elimination

MEMBER RMA

The Power of Niagara— The Quiet of an Arctic Night

What's New in Radio

(*Continued from page 265*)

framework. This arrangement makes for great rigidity, an essential feature where a number of tuning units are mechanically coupled together to be operated by a single control. In this receiver five variable condensers are coupled together to operate simultaneously by means of one wavelength tuning control.

Each of the stages of tuned-high-frequency amplification, as well as the detector stage, is completely inclosed in a burnished copper "can" or shield. This shielding together, with the provision of suitable filter devices to help isolate the stages from one another, results in a high-frequency amplifier which is very efficient and, at the same time, stable.

The receiver makes use of seven thermionic vacuum valves (or tubes). UX-201-a type valves are used except for the detector tube and the last low-frequency amplifier stage. For the detector a UX-200-a type valve is recommended and, for the last low-frequency stage, a UX-112 type power tube.

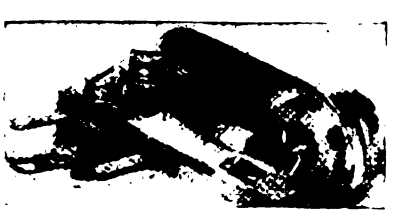
The receiver may be operated with batteries, or with "A" and "B" power-packs which supply the operating voltages after conversion from the house-lighting lines. The filament-current supply, if a battery is used, should be of the six-volt storage type. If an "A" power-pack is used, it should be capable of delivering six volts at 2 amperes continuously. For the high-voltage plate supply the use of the "Bremer-Tully 'B' Power-pack" is recommended by the manufacturer. This "B" power-pack is especially designed for use with the receiver and therefore requires no adjustment modification of any kind when used with the Counterphase. The set may be used with either an outdoor or an indoor antenna. During a test made by a member of the POPULAR RADIO LABORATORY, a short wire about 15 feet in length, stretched across the room on the ground floor of a New York apartment house, brought in a number of stations up to 500 miles distant, with great volume. If the absolute maximum of signal strength and long distance reception are desired, an outdoor antenna about 75 feet long should be used. Otherwise either a shorter outdoor antenna, or an indoor antenna of any convenient length, will be suitable.

For ordinary reception, the receiver is essentially single-control. That is, the wavelength tuning of the entire receiver is accomplished by means of the single "Selector" knob. A similar knob, marked "Volume," permits the operator of the receiver to vary the volume of reproduction to suit his taste. The other controls provided on the small front panel enable the operator to meet any unusual conditions that may exist. In tuning in extremely weak stations, for instance, a "Fine Tuning" knob is provided. This serves as a balancing auxiliary to the main "Selector" knob; but it is only required where the absolute maximum of efficiency is necessary.

A unique feature is the inclusion of a rejector as a part of the tuning circuits. This rejector or wave-trap consists of a coil and condenser which is ordinarily cut out of the circuit, but which, in cases of extreme interference between the signals of two broadcasting stations, may be cut into use by means of a switch located on the control panel. With this switch thrown to the "In" position, a small knob next to the switch is turned until the interfering station is no longer heard. The usefulness of this feature is apparent, especially in view of the overcrowded condition of the air at the present time.

At the extreme right end of the control panel is a small switch which enables the operator to make use of either two or three stages of low-frequency amplification. For ordinary reception, only two stages are necessary. In that case this "Power" switch is thrown to the "low" side. This action automatically cuts out the second stage of low-frequency amplification but leaves the first and third stages in operation. This is important, as it means that the power amplifier stage *is always in the circuit*, thus insuring the best quality of output to the reproducer (loudspeaker) regardless of the amount of amplification used.

Maker: The Bremer-Tully Manufacturing Company.



A Jack That Makes It Easier to Get a Well-balanced Panel Layout

Name of instrument: Headphone or reproducer jack.

Description: This jack fills a real need of the home set-builder. Instead of being constructed so that the springs run at right angles to the panel, this jack has the springs arranged parallel with the panel. Thus the terminals to which connections are made do not project far back into the receiver, as is the case with old-fashioned jacks. Instead, the terminals are close to the panel and off to one side. In installing this instrument on the panel, the arm bearing the terminals may be swung up or down or to either side in any manner which is most convenient and provides the shortest leads behind the panel. At the same time the mounting sleeve which projects through the panel may be installed at a point on the panel that makes for the most symmetrical layout, from the standpoint of appearance. Thus, there need be no compromise between the symmetrical lay out of the panel front and convenience of connections behind the panel.

Usage: In any receiver to provide a convenient method for connecting headphones or a reproducer.

Outstanding features: Strongly built. Compact. Easy to install.

Maker: Yaxley Mfg. Co.

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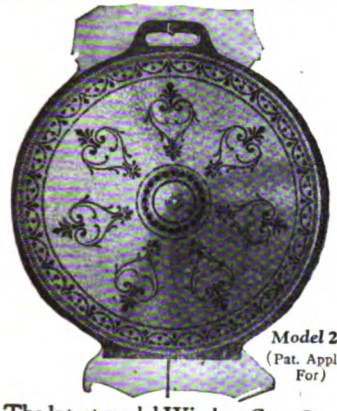
Windsor Wall or Table Type Cone Speaker Amazes Radio World



Model 210
(Pat. Applied For)

The latest model Windsor Cone Loudspeaker has astonished the world of radio. In convenience, quality of reception, and extremely low price, it far surpasses anything yet offered. The cone is 22 inches in diameter and is supported by an easel back. It can be hung up on the wall, as in the picture above, or stood upon any flat surface as shown in the picture below. It contains the famous Windsor loudspeaker unit noted for its extreme clarity and fidelity of reproduction.

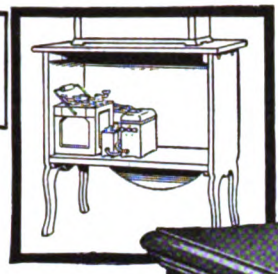
Model 210
22-inch Cone Loudspeaker with easel back

$15.00
(West of Rockies $18)
(Pat. Applied For)

Model 302 (Shown below)
With Moulded Composition Horn Loudspeaker and 18-inch Cone Loudspeaker.

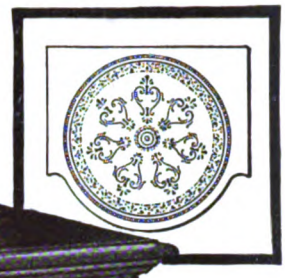
(Pat. Applied For)

In this Windsor Console is combined both the Windsor Moulded Composition Horn Loudspeaker and the 18-in. Windsor Cone Loudspeaker. The top is 30 in. x 17 in. and stands 29 in. high. Plenty of battery and equipment space is provided by large shelf in rear. Price, finished in Mahogany or Walnut **$48.00**
(West of Rockies, $55)



Rear view at left shows large compartment with ample space for batteries, battery charger, or battery eliminator, which are entirely concealed from view. Back is open for ventilation of batteries.

At right is shown the Cone Loudspeaker, with its panel, which is quickly and easily removable, allowing instant access to all batteries, battery charger, battery eliminator or other equipment and wiring.



(Pat. Applied For)

Model 200—with 22-inch Cone Loudspeaker

This Windsor Cone Loudspeaker Console is equipped with a 22-inch Windsor Cone Loudspeaker. Its top is 30" x 17" and is 29" high. The battery shelf provides ample space for batteries, charger, battery eliminator and other equipment. Beautifully finished in either Mahogany or Walnut.

Model 200

$29

Console with Cone Loudspeaker Ready for Set and Batteries
(West of Rockies, $35)

This is the Fastest Selling Line of *Loudspeakers and Loudspeaker Consoles* in the Radio World Today

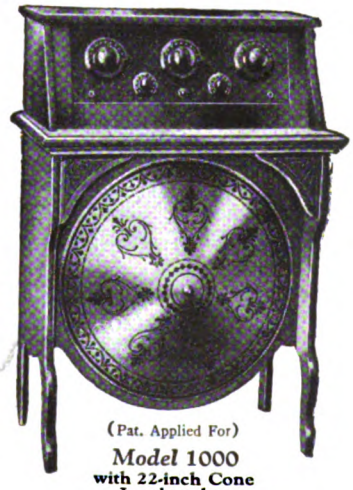
The quality of radio reception made possible by Windsor Cone and Horn Loudspeakers and Loudspeaker Consoles so far surpasses anything heard heretofore that it amazes and delights every radio enthusiast. The Windsor Line is so complete that everyone can find in it a loudspeaker, loudspeaker table, or loudspeaker console exactly to fit their particular needs.

Model 100
with Moulded Composition Horn Loudspeaker or 16-inch Cone Loudspeaker
(Pat. Nov. 18, 1924)

Above is shown a beautiful Windsor Loudspeaker Console, finished in either Walnut or Mahogany, which provides ample space on top for any radio set. The battery shelf beneath will accommodate all necessary equipment. Equipped with either Moulded Composition Horn or 16-inch Cone Loudspeaker. Size: 38 in. x 18 in., and 29 in. high. Price **$40.00**
(West of Rockies, $42.50)

To the right is shown the newest Windsor Loudspeaker Console. It is equipped with a 22-inch Cone Loudspeaker and cabinet suitable for 7-inch radio panels up to 26 inches in length. Battery shelf provides ample space for all equipment. Beautifully finished in either Walnut or Mahogany. Price (without receiving set) . . **$44.00**
(West of Rockies, $52.00)

Note to Dealers: Write or wire today for details of the highly profitable Windsor line.



(Pat. Applied For)
Model 1000
with 22-inch Cone Loudspeaker

Electrical Department

WINDSOR FURNITURE COMPANY

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Los Angeles Branch—917 Maple Avenue

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KARAS HARMONIK TRANSFORMERS

Give Maximum Quality Volume with the One Tube UNIVALVE RECEIVER

THE Univalve Receiver, having but one tube, described and illustrated in this issue of POPULAR RADIO, uses a Karas Harmonik Audio Frequency Transformer to deliver *full strength* QUALITY reception—and DELIVERS IT. All who have heard this new receiver with its multivalve tube which handles one stage of radio frequency, detector, and two stages of audio frequency amplification, using only one vacuum tube, have been mystified and amazed at its tremendous volume and the entire elimination of howls and squeals so common to many circuits. The answer lies in the newly developed circuit and the employment of a Karas Harmonik Amplifying Transformer for audio amplification.

Read the Article—Then Build the Univalve

Read the article describing the construction of this novel receiver in this issue of POPULAR RADIO. Then build the set yourself. Be sure to obtain a Karas Harmonik Transformer from your dealer, for it is used in this circuit, and no other will give such tremendous volume and such distortionless amplification. If your dealer is out of stock and you are in a hurry, you can order your transformer direct from us by filling out and mailing the coupon below. SEND NO MONEY. Just hand the postman the price of the transformer plus a few cents postage upon delivery.

Order Today—Mail the Coupon NOW

Fill out and mail the coupon today—do it NOW while this advertisement is before you. Then build the Univalve Receiver and pull in the stations on a single tube. You'll find this one of the most interesting sets you ever assembled.

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1023 Association Building
CHICAGO

Karas Electric Co.
1023 Association Building, Chicago

Please send me 1 Karas Harmonik Audio Frequency Transformer for which I agree to pay the postman $7, plus postage, upon delivery. It is understood that if I am not perfectly satisfied with my purchase within 30 days I may return it for full refund of purchase price.

Name.....

Address.....

City..... State.....
(If cash accompanies order we will prepay postage.)

The obverse of the medal; this original is two-and-one-half inches in diameter.

The Popular Radio Medal *for* Conspicuous Service

TO every radio amateur, to every amateur experimenter and broadcast listener, who is instrumental in alleviating human suffering or saving human life, directly through the medium of radio, recognition will hereafter be extended in the form of a medal that shall be known as "The Popular Radio Medal for Conspicuous Service." This medal is unique within the realms of radio in that it shall be awarded, not for scientific achievement or invention, but for service to humanity.

To insure a fair and unbiased consideration of all claims, a Committee of Awards has been appointed that includes five distinguished citizens of international fame. To assist this Committee of Awards, an Advisory Committee has been appointed that numbers among its members some of the most eminent citizens of the United States, including representatives of many of our most distinguished institutions.

The conditions under which the medal will be awarded are here specified:

1. The medal shall be known as the Popular Radio Medal for Conspicuous Service.
2. The medal shall be awarded, without discrimination as to sex, age, race, nationality, color or creed, to those radio amateurs, radio experimenters, broadcast listeners and other non-professionals through whose prompt and efficient action radio is utilized to perform an essential part in the alleviation of human suffering or in the saving of human life within the territorial confines of the United States and its possessions, or in the waters thereof.
3. The medal shall be awarded by a Committee of Awards that shall not exceed five in number. No member of this Committee shall be an employee, officer or stockholder of POPULAR RADIO, INC., nor shall any such employee, officer or stockholder have a vote in the deliberations of the Committee.
4. An advisory Committee, which shall cooperate with the Committee of Awards and which shall be particularly charged with the responsibility of making recommendations for awards of this medal, shall be made up of men and women who, because of their interest in the public welfare or because of their connection with institutions that are consecrated to public service, are in positions to bring to the attention of the Committee of Awards the exploits of candidates who are within their own special fields of activity.
5. The medal will be awarded for services rendered since Armistice Day, November 11, 1918.
6. Recommendations for awards may be submitted to the Committee of Awards at any time and by any person. Every recommendation must contain the full name and address of the candidate, together with a detailed account of the accomplishment on which the proposed award is based, and must be accompanied by corroboratory evidence from persons who have first-hand knowledge of the circumstances and whose statements may be verified to the satisfaction of the Committee of Awards.
7. The medal will be awarded to as many individuals as qualify for it and at such time as the Committee of Awards may authorize.

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Rectifiers
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A Type for Every Radio Need

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The reverse; the name of each recipient will be engraved in the space provided.

ll considerations not specified herein shall be ft to the discretion of the Committee of wards.

ll communications to the Committee of Awards ay be addressed to—

Secretary of the Committee of Awards, POPU- Radio Medal for Conspicuous Service, 627 43rd Street, New York.

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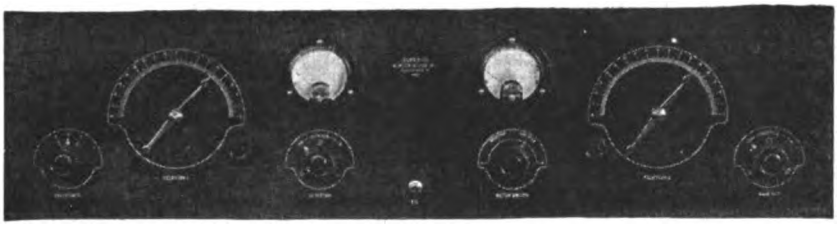
Norden-Hauck Super-10

AROUND THE WORLD WITH THE U. S. NAVY



Panel size, 36"x 9"x ¼" Super 10-tube Standard Admiralty Model Weight: 55 lbs.

A SUPER-10 has been installed on board the "U. S. S. Wright," now sailing for Asiatic waters with the U. S. Aircraft squadrons. This receiver will also be used for entertaining civilian representatives at various ports of call.

A New and Advanced Model
Highest Class Receiver in the World

THE NORDEN-HAUCK SUPER-10 is an entirely new and advanced design of Receiver, representing what we believe to be the finest expression of Modern Radio Research Engineering. It is the product of years of experience devoted exclusively to the attainment of an ideal Broadcast Receiver—regardless of cost.

Results obtained in every respect will upset all your previous ideas of good radio reception. The unusually large number of unsolicited testimonials constantly being received from users—concerns and individuals of international repute—indicates the absolute superiority of the NORDEN-HAUCK SUPER-10.

You, too, may enjoy the advantages of this wonderful receiver at a surprisingly moderate cost. Here are only a few of the host of features that place the NORDEN-HAUCK SUPER-10 far in advance of competition.

—10 tubes employed to give perfect reproduction with unlimited range and volume power.

—Super selectivity on all wave lengths.

—Built to Navy Standards.

—Wide wave length range without change of coils, 200-550 meters full.

(Adaptable 35 meters to 3600 meters if desired.)

—Use Loop or Antenna.

—Simple to operate, having only two major tuning controls.

—No Harmonics. Signals are received only at one Point.

—Special Power Audio Amplifier, operating any loudspeaker and eliminates necessity of external amplifier.

—Can be operated directly from house current with socket power devices.

—Thoroughly shielded at all necessary points.

Complete Price List for Socket Power Operation

1	Norden-Hauck SUPER-10, completely constructed and laboratory tested	$307.00
*1	Heavy-Duty 200 V. "B" Eliminator and Tube, 50/60 cycle A/C 110 V.	42.50
1	Automatic "A" Power Supply, complete	29.50
10	Tested Tubes, including Power Tube	22.50
1	Western Electric Cone Speaker, 540AW or Farrand Sr., and Plug	32.60
1	Set Antenna Equipment, complete	5.00
2	"C" Batteries	2.00
	TOTAL COST OF ALL ITEMS—NOTHING ELSE REQUIRED	$441.10

* 25/30 cycle A/C current, $47.50.

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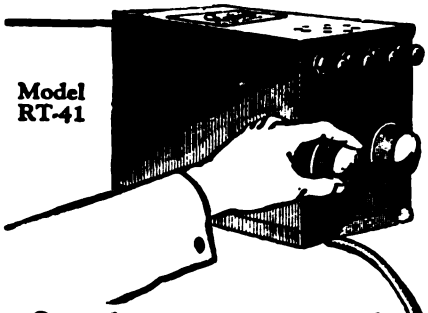
Never Before—Such Tone Quality



Model RT-41

Sterling perfected "B" Eliminator control gives this added Advantage

PERHAPS you regard a "B" Eliminator merely as a means of doing away with the expense and nuisance of forever replacing worn-down "B" Batteries.

But with the Sterling "B" Eliminator, there is a tremendous improvement in *tone quality* too! The secret of this amazing tone quality lies in the extremely fine control of the "B" voltage.

This definite Sterling advantage in tone quality is possible only by using first quality materials, high standards of manufacture, backed by 20 years of Sterling electrical experience.

This Sterling Dependable Light Socket Power Unit RT-41

is the ideal "B" Power supply for sets using as many as 5 tubes. It takes up no more room than a 45 volt dry battery—yet it gives three times the power—135 volts.

Just right for Radiolas 25 and 28.

Price complete with CX 313 tube . . $28.00

Also Raytheon Tube Types for high-powered sets

R-97— "B" and "C" [illegible]

WHAT READERS ASK

CONDUCTED BY DAVID LAY

IN justice to our regular subscribers a nominal fee of $1.00 per question is charged non-subscribers to cover the cost of this service, and this sum must be inclosed with the le of inquiry. Subscribers' inquiries should be limited to one question or one subject.

How to Increase Amplification in a Low-Frequency Amplifier

QUESTION: My receiver includes two stages of transformer-coupled, low-frequency amplification, both transformers being of the 4 to 1 ratio type. I want to add another stage in order to increase the volume; but I have been told that the use of another stage of transformer-coupled amplification is not practical. If this is true can I add a stage of resistance-coupled or impedance-coupled amplification?

—BENJAMIN COHEN

ANSWER: As your transformers are both high-ratio units it is doubtful whether you would get any better results by adding a third stage of amplification, regardless of the type of coupling used in the added stage. If you do add another stage it is likely that you will have to "doctor up" the amplifier with shunt resistances and condensers with the result that your volume will be increased little, if at all.

An easier, and far more practical plan would be to install a power tube of the UX-112 type in the second stage of amplification and increase the "B" battery potential on this tube to 135 or 157 volts, with the proper "C" bias, as recommended by the tube manufacturer. This should give you a considerable increase in volume and would have only a simple change in the connections in the grid and plate circuits of the last tube. The proper connections for this change were given in this department in the November, 1926 issue.

* *

How to Control Oscillation in a Superheterodyne

QUESTION: My superheterodyne receiver gives me some trouble, when I try to tune in weak signals, because I cannot bring the intermediate amplifier gradually up to the point of oscillation. As I turn the potentiometer knob toward the negative side, the circuit "flops" into oscillation suddenly, but not until the arm is almost at the negative end at the resistance winding. In another superheterodyne receiver the control of oscillation was much more gradual and smooth and I could keep the circuit just under the point of oscillation and obtain extreme sensitivity this way. In the receiver the oscil tion took place when the potentiome arm was just beyond the middle of t winding. The potentiometer I using now has a resistance of 200 oh It is connected across the "A" batt and the grid returns of the three int mediate amplifier tubes are connec to the arm. Would it help me to u potentiometer of higher resistance? not, is there anything else you can s gest?

—HARRISON RIDE

ANSWER: The use of a 400-ohm po tiometer would help you slightly inasm as it would give you a little finer adj ment; but the help from this source wo hardly be sufficient to warrant the cos a new potentiometer. If your ampli does not break into oscillation until y potentiometer arm is almost at the ne tive side, there is no necessity for ha the grid returns of all your intermedi tubes connected to the potentiometer. is more than likely that the grid ret connections of the second and third plifier-tubes can be made direct to "A" (—) terminal, leaving the re from the first amplifier tubes connecte the potentiometer. This will remedy trouble and will give you much better trol of oscillation.

* *

How to Build an Antenn Mast Without Puncturing t Metal Roof

QUESTION: I am the "despised la lord" of an apartment house. Whe constructed the house I went to c siderable expense in installing cop cornices to add to the beauty of house. Not wishing to have this exp sive beauty marred by the erection numerous unsightly antenna wires the roof it was necessary for me to p hibit the erection of masts. The dem for radio has increased to such an ext now, however, that I can no longer sist on the strict observance of suc rule. Can you give me specifications the erection of poles to which ante wires may be attached, which will secure, of good appearance, and wh will require no puncturing of the r

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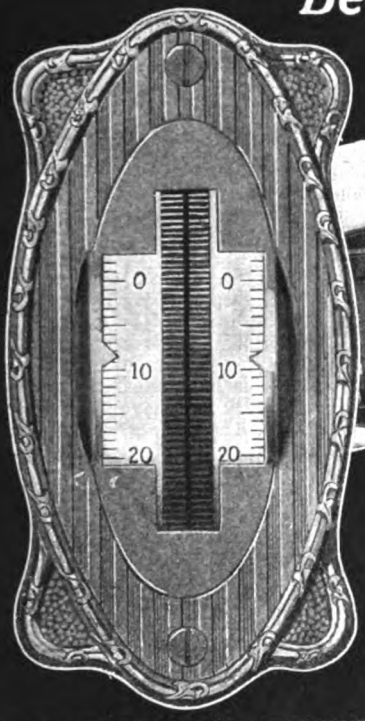
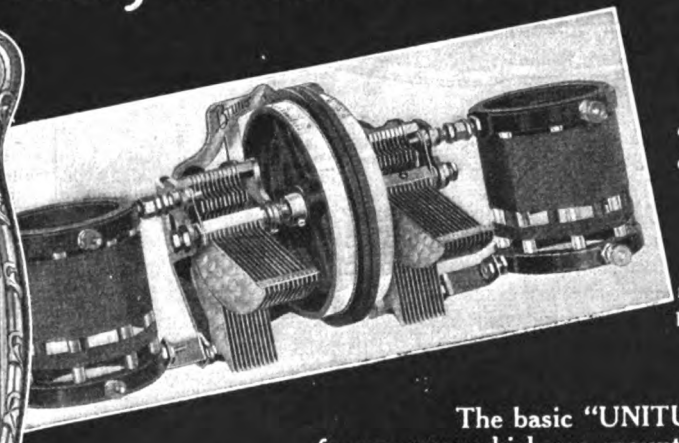
THE **Simplicity** of tuning
THE **Efficiency** of the Bakelite Shaft Condensers and Quatzite Coils
and the **Beauty** of the Bronze Front Plate

"Bruno" UNITUNE THE HEART OF THE CIRCUIT





Makes the "UNITUNE" the most desirable tuning device ever designed.

ALL BRUNO "UNITUNES" may be mounted on a panel with only two screws.

The basic "UNITUNE" consists of a frame upon which are mounted two condensers operated independently by two bakelite drums projecting thru a beautiful bronze plate. It may be obtained in all standard capacities. Completely assembled it lists at $11.00.

Other "UNITUNES" assembled with one or more Quartzite Coils for all popular circuits range from $12.00 to $21.00.

Booklet of Instruction and Blue Prints—25c

BRUNO RADIO CORP., LONG ISLAND CITY, N. Y.

For the Beginner
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HAND BOOK
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Popular Radio

Kendall Banning, Editor, and **Laurence M. Cockaday**, Technical Editor of POPULAR RADIO, have compiled a book that will prove to anyone that he can build a set which will give distance, selectivity and tone volume, and at the same time a very definite basic knowledge of radio.

BUILD YOUR OWN SET AND SAVE MONEY

In "How to Build Your Radio Receiver," you will find complete specifications, constructional diagrams, photographs and instructions for building all of the following sets:

A $5 Crystal Set
The Haynes Single-Tube Receiver
A Two-Stage Audio-frequency Amplifier
The Cockaday 4-Circuit Tuner
A 5-Tube Tuned Radio-frequency Receiver
The "Improved" Cockaday 4-Circuit Tuner
The Regenerative Super-Heterodyne Receiver

ADVISORY SERVICE ALSO FREE

POPULAR RADIO maintains a big modern laboratory with a trained staff of investigators under the personal supervision of Mr. Cockaday. This Laboratory is always available through our Technical Service Bureau to answer, free to subscribers, by personal letter any problems you encounter which are not answered in either the "Handbook" or the magazine.

SPECIAL BOOK OFFER

You can secure a copy of "How to Build Your Radio Receiver" FREE, and have all the privileges of the Technical Service Bureau without additional expense, if you will send a remittance of $3.00 in full payment of 12 months' subscription for POPULAR RADIO. (Or as an alternative, you may have the book and privileges of the Technical Service Bureau with POPULAR RADIO for 7 months only—for $2.00. A two dollar bill will do.)

Remember you take no chance—we will refund your money in full if you are not more than satisfied.

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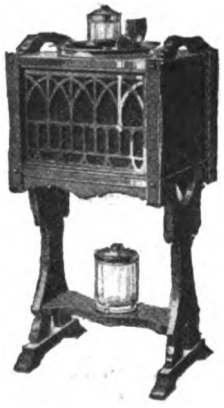
Department 35
627 West 43rd Street, New York



Announcing
the first of a series of new models of
TIMBRETONE
REG. U.S. PAT. OFF.

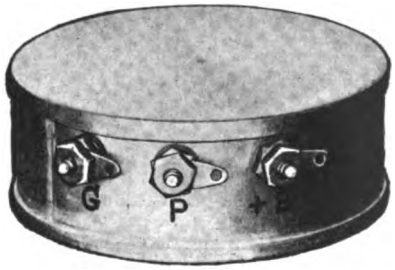
Combined with the utility of a smoking stand is a loud speaker. Carry it about and have it where you want it—on the porch or along side of your easy chair.

Sales offices

SANFORD BROS.

CHICAGO	30 W. Walton Pl.
CHATTANOOGA	615 Broad Street
SEATTLE	Am. Bank Bldg.
SAN FRANCISCO	311 Minna St.

Factory: TIMBRETONE MFG. CO., Hoosick Falls, N. Y.



Shielded Tuned Radio Transformer, No. 30

SICKLES
Diamond-Weave Coils

The new Sickles Shielded Tuned Radio Transformer prevents both outside and local interference. It is remarkably compact, sharp-tuning, sturdy.

Sickles Diamond-Weave Coils have established an enviable reputation for low distributed capacity, low dielectric losses, and large range of frequency with small variable capacity.

The ideal coil for the Na-Ald Localised Control Tuning Unit and the Na-Ald Trauphonic Assembly.

There are Sickles Diamond-Weave Coils for all leading circuits.

THE F. W. SICKLES CO.
134 UNION STREET
SPRINGFIELD :: MASS.

No.	Coil Prices	
30	Shielded Transformer	$2.00 each
24	Browning-Drake	7.50 set
18A	Roberts Circuit	8.00 set
25	Aristocrat Circuit	8.00 set

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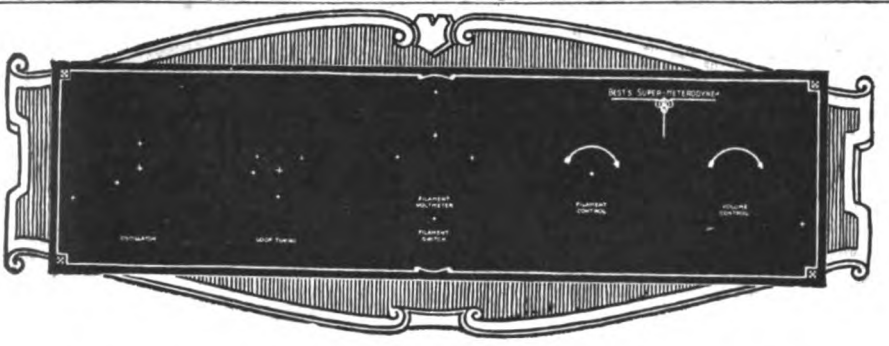


Best's Super, Karas, H.F.L.

FORMICA is supplying handsomely decorated Kit Panels for leading kit sets through leading jobbers and dealers all over the country. These panels make it possible to build at home a very good looking set. There are two sizes of Best's Superheterodyne, Karas Equamatic front and sub panels, H.F.L. Nine-In-Line Superheterodyne with sub panel, Victoreen single dial and two dial control. There is also an Infradyne 7″x 28″ and one 7″ x 30″, Aerodyne, St. James 8 Tube, Browning-Drake National, Madison-Moore Superheterodyne and Camfield Duoformer.

Special panels cut to size and Formica Tubing are also available for amateurs.

The FORMICA INSULATION COMPANY
4641 SPRING GROVE AVENUE CINCINNATI, OHIO

Hear the FORMICA Orchestra Tuesday 9 to 10 over WLW

FORMICA

Formica has a Complete Service on Insulating Material for Radio Manufacturers

MODEL "C" CHEST

Cabinets in stock—have piano hinge and are 10″ deep—grooved front top rail being removable. Illustration shows gold line wood panel to match.

Sizes	Walnut Only	Panel to Match
7x18-10	$15.00	$1.26
7x21-10	17.00	1.47
*7x21-12	17.50	
7x24-10	19.00	1.68
*7x26-10	21.00	1.82
7x30-10	23.00	2.10
*7x28-11	23.00	1.96

*For Hammarlund-Roberts Hi-Q Receiver.
*For Madison-Moore Receiver.
*For Victoreen Receiver.

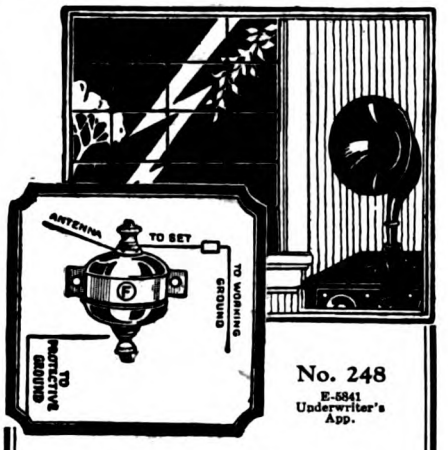
Special Cabinet (Mahogany or Walnut) for **Univalve Receiver** 7x15 panel, 8″ deep $8.00

Walnut Infradyne Cabinet
$26.00
or
LC-27 Cabinets
Mahogany or Walnut with Baseboard
$18.00

The LC-27 cabinets have 25° slope and take 8″ x 26″ panel. They are full 10″ deep back of the panel.

WRITE FOR folder showing complete LC-27 Line and other Radio Furniture.

CORBETT CABINET MFG. COMPANY
St. Marys - - Pennsylvania



No. 248
E-5841 Underwriter's App.

"Little Joe"
Lightning Arrester

Especially designed for Radio Work. Made of porcelain, small, neat, rugged and serviceable. Can be suspended on antenna or fastened to wall.

Ask Your Dealer

M'f'd by CIRCLE F MFG. CO.
Trenton, New Jersey

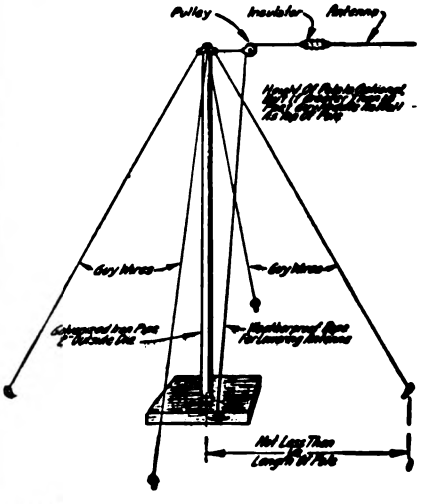
ing? I would prefer to use iron pipes. My idea is to erect three or four poles at my own expense, and insist that all antennas must be attached to these poles. Or perhaps allow tenants to erect their own poles provided they comply with the specifications which I designate.
—A. E. M.

ANSWER: Any support used for antenna wires should be either firmly imbedded in the roof, or securely guyed with wires. A practical scheme that does not involve puncturing of the roof surface is shown in Figure 1. The step or seat for the pole is made of a three-foot piece of 4 by 10-inch planking with a hole, just large enough to accommodate the pole, bored half way through from the center of one side. The planking is placed flat on the roof, with the hole uppermost, at the point where the pole is to be erected. Next, the pole is prepared, with four guy wires attached to, or near, its top end.

A pulley should also be attached to the top end of the pole; more than one pulley if the pole is to support more than one antenna. Each of these pulleys should be equipped with a piece of weatherproof rope at least twice as long as the pole. The ropes are run through the pulleys and the two ends of each rope are then secured to the bottom of the pole.

The guy wires may be No. 12 galvanized iron wire if the pole is to be used for not more than three antennas. If more antennas are attached the guy wires should be heavier, and preferably stranded. The anchorage for the guy wires should be predetermined. These anchorages may be made to the lower end of nearby vent pipes or other superstructures on the roof, or may be attached to the brick wall by means of anchored screw eyes. In any event, the point to which the anchored end of the guy wire is fastened should be distant from the base of the pole by at least ¼ of the height of the pole.

With the above preparations made, the pole is raised, and seated in the hole in the plank. While it is held in an upright position the four guy wires are made secure to their anchorages. When this has been done, the erection job is complete. The weight of the pole, plus the downward pull of the



HOW TO BUILD A MAST FOR A METAL ROOF

FIGURE 1: *This antenna mast has been especially designed for buildings that have a metal roof that might be ruined by nail or screw holes. The iron pipe, that forms the mast, is set into a large, square block of wood; the guy wires may then be attached to the lower end of vent pipes or to any other superstructure on the roof.*

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ny wires will hold the plank securely in lace without the aid of nails or other ttachments. In putting up the antenna t is only necessary to attach the wire to ne end of the rope which was previously un through the pulley, and then pull the ope taut; the wire should be attached ith an insulator.

The lower end of the rope is then tied to cleat provided either at the lower end of he pole, or on the plank.

The height and diameter of the iron pipe ill depend on the requirements. For the upport of one or two antenna wires a -inch galvanized pipe is suitable if it does ot exceed 18 feet in length. Smaller iameter pipe is liable to bend under the train of the antenna wires.

* *

Shall I Build a Super?

QUESTION: Just what are the advanages of a super-heterodyne receiver as gainst an average five-tube, tuned-adio-frequency receiver? Which type f receiver, would be the more practical or use under average conditions?

—LESTER DRAKE

ANSWER: A well-designed and well-constructed super-heterodyne receiver has ertain advantages over other types of reeivers; but there are advantages on the ther side. In reaching a decision as to hich type of receiver to construct, it will e necessary for the builder to take into onsideration all of these advantages as pplied to his particular requirements and onditions.

The modern super-heterodyne receiver s simple to operate and uses only two uning controls. In addition to these two ontrols there is usually another to regulate the volume of reproduction. These hree represent all of the necessary adjustments required in operating the receiver.

The super-heterodyne receiver is extremely selective—much more so than the verage tuned-radio-frequency receiver. On the other hand the selectivity of the "super" may be so great as to cut sidebands and thus result in a poor quality of reception. Usually the selectivity will vary with the sensitivity; that is, when the "volume" control is adjusted to provide extreme sensitivity the selectivity will also be high and this aids materially in tuning in distant stations. When the receiver is adjusted for lower sensitivity, as in normal use, the selectivity will be decreased; but even then it is usually greater than that of the average receiver.

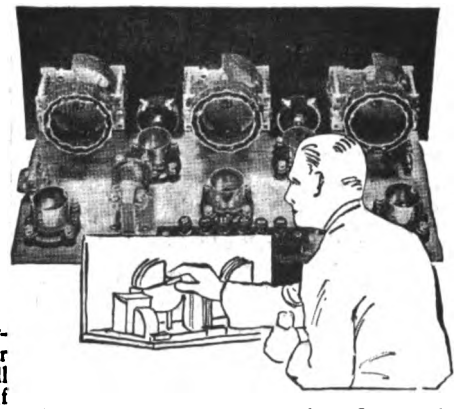
The super-heterodyne receiver is so sensitive that the use of an outdoor antenna is not necessary. A loop measuring two feet across supplies sufficient pick-up to bring in stations at great distances. In this respect the super will bring in as great or greater distances, using a loop, as a good five-tube receiver which uses an outdoor antenna.

Finally, an eight-tube super-heterodyne receiver need be no larger in physical dimensions than a five-tube, tuned-high-frequency receiver; and it can be operated successfully with dry-cell tubes.

To sum up; the super-heterodyne receiver has the advantages of simplicity of operation, extreme sensitivity and selectivity, requires only a loop antenna, and may be made extremely compact. It is therefore the ideal receiver for portable use.

The disadvantages of the super, on the other hand, are greater operating cost (for filament supply); usually higher cost to construct, more susceptible to interference from local electrical disturbances and static; stations tune in at two distinct settings of one of the dials (oscillator).

$75 A WEEK BUILDING RADIO SETS
—*in your spare time*



JOIN the Radio Association of America. Learn how to build and repair radio sets. The Association will train you—start you out in business if you wish. Be the radio "doctor" of your community. $3 an hour upwards easily made. Radio offers you a big money-making opportunity right now.

Earns $500 in Spare Hours

"I have at last found myself," writes Lyle Follick, Lansing, Michigan, "I have already made over $500 building radio sets after working hours." Werner Eichler, Rochester, N. Y., writes, "I have made over $50 a week in my spare time."

Our members are starting radio stores, increasing their salaries, securing better positions, passing radio operator examinations, earning big money for the most enjoyable kind of spare-time work.

What a Membership Means

A membership in the Radio Association of America gives you the most up-to-date and thorough training in the Science of Radio.

You're taught how to build and repair all kinds of sets. You're given the training you need in preparing for a Licensed Radio Operator's examination. You receive the privilege of buying parts at wholesale prices.

You're helped to make money.

Join the Association Now

If you're interested in Radio for either pleasure or profit, join the Association without delay, because we have a plan whereby your membership may not—need not—cost you a cent. Only a limited number of these memberships are acceptable. Write now for details. Write before it's too late.

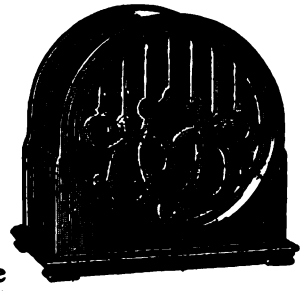
This Association has prepared a beautiful book that gives figure-facts regarding the profit possibilities of the Radio Industry, the purpose of the Association, and the details of the Special Membership Plan.

Mail This Coupon

RADIO ASSOCIATION OF AMERICA
Dept. PR-3—4513 Ravenswood Ave., Chicago

Send me your book and details of your Special Membership Plan.

Name.....
Address.....
City.....State.....



The
AMPLION CONE
ably stands the severest test you can give

—clear reproduction of speech

YOU will enjoy the many speeches and talks that will be broadcast this winter much more if you attach an Amplion Cone to your radio set.

The secret of its fine performance lies in the matchless Amplion unit which is assembled with the Cone in a handsome mahogany cabinet, 14" x 14" x 9".

Model AC12—$30

Other Amplion reproducers from $12 to $135

Ask your dealer for a demonstration or write for booklet illustrating and describing all Amplion models.

THE AMPLION CORPORATION OF AMERICA
Suite X, 280 Madison Ave., New York

The Amplion Corporation of Canada Ltd.—Toronto

AMPLION

A good name
NA-ALD
in radio

Use Power tubes for good quality at full volume

Simply adapt to your set with

Connectoralds
(Reg. U. S. Pat. Off.)

The use of a Power Tube in the last audio will very greatly improve your tone quality. No change in set wiring is necessary when Connectoralds are used.

For UX 171 and UX 112 Tubes, Na-Ald 112 Connectoralds are recommended for maximum volume with storage battery sets. These tubes will deliver without distortion several times the volume of the regular 201A. Price $1.50.

For UX 120 Tubes in UV 201A sockets, the Na-Ald No. 120 Connectorald should be used. To convert a storage battery set to dry batteries with ample loud speaker volume, use a UX 120 tube in the last audio stage with the 120 Connectorald and UX 199 tubes with 419X Adapters in the other sockets. Price $1.25.

For the UX 120 Tube in UV 199 sockets, ample loud speaker volume without distortion is obtainable from any set equipped for UV 199 tubes by means of the UX 120 or equivalent tube, with the Na-Ald No. 920 Connectorald. The tube is raised slightly, but provides for its use in most sets with limited headroom. Price $1.25.

For UX 120 tubes in the UV 199 sockets of the Radiola Superheterodyne Semi-Portable and Radiola Super VIII. These excellent Superheterodynes will deliver ample volume for loud speaker operation when equipped with the UX 120 used with the Na-Ald No. 420 Connectorald. Price $1.25.

ALDEN MANUFACTURING CO.
Dept. 320-C — Springfield, Mass.

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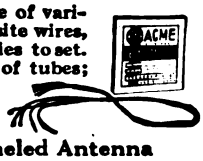
ACME
CELATSITE
BATTERY CABLE

—a silk-covered cable of varicolored Flexible Celatsite wires, for connecting batteries to set. Prevents "blowing" of tubes; gives your set an orderly appearance.



Stranded Enameled Antenna

Best outdoor antenna you can buy. 7 strands of enameled copper wire; maximum surface for reception. Prevents corrosion and consequent weak signals.

The Original Celatsite

—a tinned, copper bus bar wire with non-inflammable "spaghetti" covering, for hook-ups. 5 colors; 30-inch lengths.
We also offer the highest grade of "spaghetti" tubing for Nos. 10 to 18 wires. 5 colors; 30-inch lengths.

Flexible Celatsite

Flexible, stranded wire for point-to-point and sub-panel wiring. Non-inflammable "spaghetti" covering. In black, yellow, green, red and brown; a color for each circuit. Put up in 25-foot coils.

Send for folder
THE ACME WIRE CO., DEPT. P
NEW HAVEN, CONN.

ACME WIRE
MAKES BETTER RADIO

Deal with New York's Largest Radio Store

LC-27 $85.20
HAMMARLUND-ROBERTS
$85.00
SILVER SHIELDED SIX
$95.00
Improved Browning-Drake
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SARGENT INFRADYNE
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SENIOR POWER PACK
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Intermediate Power Pack
$47.50
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UNIVALVE RECEIVER
$39.95
HENRY LYFORD and other popular circuits
WRITE FOR DEALERS' PRICES

City Radio Stores
110 West 42nd Street, New York
Downtown Store :: 79 Cortlandt Street

The BEGINNER IN RADIO

CONDUCTED BY ARMSTRONG PERRY

The Use of House Lighting Wires for Antennas

THE difficulty or expense of providing suitable antennas still deters many folks from using radio.

The wire, insulators, lightning arrester, lightning switch and labor for an outside aerial may add a considerable percentage to the cost of a receiver, and in addition there is sometimes difficulty in arranging with property owners or people who have antennas on the same building. The use of a loop antenna means that a sensitive and fairly expensive receiver must be purchased; several more tubes are needed to amplify the small amount of energy that is picked up by a loop—enough to make the broadcasts audible even in a pair of good phones.

Old-time amateurs used to cut in on light and telephone wires when no better substitutes were available. When the broadcasting era arrived, manufacturers placed on the market devices such as the amateurs formerly made for themselves, in order to connect with the wires. Some of these antenna plugs, as they are called, may be purchased for a dollar or less and most of them may be used with entire satisfaction under most conditions in houses where there are electric lights.

To the uninitiated it may seem dangerous to screw a plug into an electric light socket and thus connect wires that are known to carry a current strong enough to kill a man, with fragile and sensitive apparatus that is handled while in operation. The fact is that the antenna plug cannot pass the lighting current into the radio apparatus. It does pass the energy produced in the wire by the radio waves, but it is through a condenser whose metal plates are insulated from each other so effectively that no current such as that employed to light an electric lamp can possibly pass from one to the other. Even though the button is turned on, so that a lamp would light if screwed into the socket, the wires are "dead" all the way back to the switch, while the antenna plug is in position, unless they are connected by some other means. Current can flow only when there is an unbroken circuit, or when a break in the circuit is so narrow that the current can leap the gap, and the circuit is effectively broken so long as the antenna plug is in position.

The radio energy that the plug passes is entirely different from the lighting current. The condensers in the antenna plug may be compared with a glass window that stops the air currents but freely passes the light and sound waves because they pass the radio current

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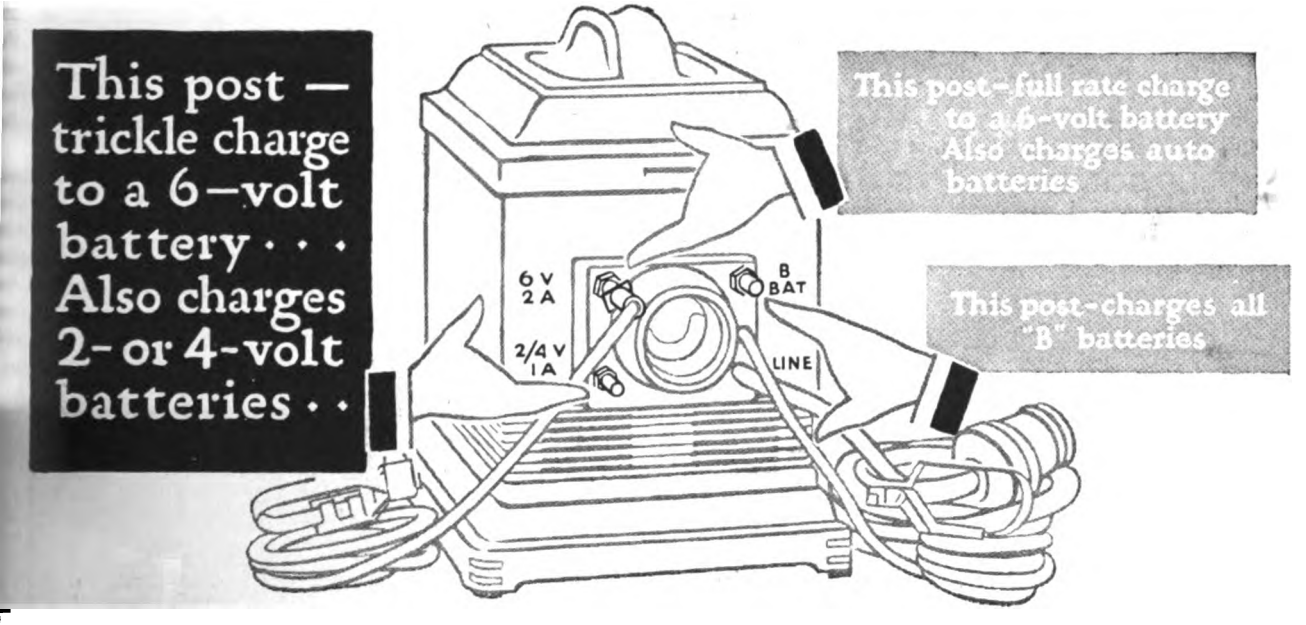
"Trickle Charge" with a 2 ampere Tungar

When you have a Tungar you have a complete battery charging outfit. It will deliver either a full rate or a trickle charge. Clip it on one post and you will get a full 2 ampere boost, on another, a trickle. It is just the kind of device needed to insure perfect reception at all times. In addition to charging all radio "A" and "B" batteries, Tungar charges auto batteries, too.


This post — trickle charge to a 6-volt battery · · · Also charges 2- or 4-volt batteries · ·
This post-full rate charge to a 6-volt battery Also charges auto batteries
This post-charges all "B" batteries
6 V 2 A
2/4 V 1 A
B BAT
LINE

Tungar
REG. U.S. PAT. OFF.
BATTERY CHARGER

East of the Rockies:

2 ampere Tungar . .	$18
5 ampere Tungar . .	$28
Trickle Charger . . .	$12

Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

Merchandise Department
General Electric Company
Bridgeport, Connecticut

GENERAL ELECTRIC

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WE SELL GENUINE FORMICA PANELS

This Desk is made of Walnut or Mahogany and not Gum, Poplar etc.

A beautiful Table of genuine Walnut or Mahogany veneer, Top 5-ply. High-grade lacquer finish rubbed to piano finish. Has ample leg-room and battery spaces. Size top 17 x 36 in. Height 28 in. Battery spaces 8 in. wide, 9½ in. high, 13 in. deep. Crated 56 lbs.

$16.75 EXPRESS PREPAID TO Ala., Del., D. C., Ga., Ky., Md., N. C., Ohio, S. C., Tenn., Va., W. Va.

$18.50 EXPRESS PREPAID TO Ark., Colo., Conn., Fla., Ill., Ind., Iowa, Kan., La., Me., Mass., Mich., Miss., Mo., N. H., N. J., N. Y., Okla., Pa., R. I., Tex., Vt., Wis.

$20.00 EXPRESS PREPAID TO Minn., Mont., Nebr., N. M., N. Dak., S. Dak., Wyo.

$21.50 EXPRESS PREPAID TO All other states.

Cash with order or C.O.D. if one-half price comes with order.

GENUINE GRADE M FORMICA PANELS. We guarantee these to be perfect, cut true, edges smooth.

7 x 18 x 3/16	$2.50	7 x 26 x 3/16	$3.65
7 x 21 x 3/16	2.75	7 x 28 x 3/16	3.85
7 x 24 x 3/16	3.15	7 x 30 x 3/16	4.10

Postpaid in U. S. Deduct 25c if you order both a cabinet and panel from us. Both by Express collect. Your choice Black, Wal. or Mah. color.

CABINET FOR UNIVALVE RECEIVER $4.50 Walnut or Mahogany finish. Formica panel 7 x 15 x 3/16 $2.25 postpaid. Wal., Mahogany or Black color.

We Have a New Cabinet—Send For Complete Catalogue—Free.

THE SOUTHERN TOY COMPANY, Inc.
Hickory, North Carolina

I. C. A.
PANELS & PARTS
for the New
UNIVALVE RECEIVER

Featured in This Issue

Add to the appearance as well as the performance of this phenomenal set by giving it an I.C.A. front panel of Insuline or Bakelite. Either of these standard insulating materials will provide highest insulating efficiency, insuring better reception.

Drilled and engraved front Panel for Univalve Receiver, 7 x 15 x 3/16 in., in Insuline $3.00; Bakelite, $4.50. Binding Post Strip, 1 x 9 x 3/16 in., Bakelite, 50c.

I. C. A. Panels in hi-gloss Insuline or Bakelite are furnished for over 70 popular circuits, including those sponsored by "Popular Radio." Decoration by the beautiful Etch-O-Gravure Method. All panels drilled ready for mounting. We also furnish Sub-panels for practically all well known circuits. Plain Panels in Insuline or Bakelite, black and wood finishes, in all standard sizes.

I. C. A. INSULATION PARTS
Make your set "Better" and "Better Looking"!!

I.C.A. Insulation Parts give your set that much-desired "professional finish" sought by the home set builder. I.C.A. Products include: Tubing; Spaghetti Tubing; Rods; Sub-Panel Mounting Brackets; Sockets; Binding Post Panels; Vernier Dials; Pointer Knobs; Knife Switches; Three-Stage Resistance Coupled Amplifier; etc.

Write today for illustrated Catalog P-3

Dont take substitutes for the genuine I.C.A. Products. If your dealer can't supply you write us direct.

INSULATING CO. of AMERICA, Inc.
59 Warren St. New York City

A NEW FREE SERVICE
To Set Builders

POPULAR RADIO

Laboratory tested sets are easier to build if you use our FREE PICTURE WIRING DIAGRAMS with our

SIMPLIFIED FULL SIZE BLUEPRINTS

Just Tear this Advt. out

Let us Quote You on—

Gentlemen: Without obligation, send me full information and prices on sets which I have marked X.

☐ Univalve Receiver
☐ Cockaday's LC-27
☐ Improved Browning-Drake
☐ S-C, Single control, All Wave
☐ Hammarlund - Roberts Hi-Q
☐ PORTABLE TEST BOARD
☐ QUALITY AMPLIFIER
☐ SHORT WAVE EQUIPMENT

I enclose $1.00 for Simplified Blueprints

A radio set constructed from one of our kits is not only easier for the experimenter to build but its appearance both inside and out, makes it more valuable to you.

Every Stamford Shop Kit includes a set of full size simplified Blueprints. An instrument layout shows every part in exact size and position. A picture-wiring diagram shows where and how to connect each wire. By following the wiring plan of the designer your set cannot fail to perform more efficiently.

Our Kits contain everything needed to complete the set, down to the last piece of buss bar and screw. Every panel is machine-drilled and artistically decorated.

Check opposite the sets you are interested in for complete data and prices of kits and parts.

Cockaday's LC-27 Custom Built
Write for Prices on Various Models

Diamond-of-the-Air 5-TUBE KIT—
Complete Parts $37.50
Licensed under Armstrong Patent No. 1,113,149

RADIO SHOP OF STAMFORD
20 Worth St. Stamford, Conn.

The antenna plug is in two parts. One part is a standard screw plug such as is inserted into a light socket when a floor lamp or other electrical device is to be connected; the other part is larger and has two prongs that fit into slots in the screw plug. Inside this larger piece are two small condensers. Outside is a binding-post terminal for each of these condensers. The condensers may be of different values and connecting the receiver with one of them may give better results than can be obtained through the other. The directions usually show several different connections, sometimes as many as seven, and one or more of these, in all probability, will give satisfactory results in your set.

In some cases better results are obtained with the button turned on and in other cases with it turned off.

It is foolish in this day of entertaining and educational broadcasts to permit anything (and especially any difficulty about an antenna), to prevent the full enjoyment of the benefits of radio.

The lamp-socket antenna may not bring in as many stations as could be heard with an outside wire, but it can be used with real satisfaction by millions who are within easy reach of some of the best broadcasting stations in the country.

In hundreds of communities an antenna plug and a cheap crystal detector outfit, costing less than $10.00, will give the user most of the advantages enjoyed by many families that have purchased expensive apparatus.

TWO RADIO OPERATORS WHO HAD A GOOD TIME

Last summer the two radio operators under the loudspeaker horn were sent from New York where it was ninety in the shade, to Estes Park, Colorado, where a pair of blankets felt good at night. They set up and operated a broadcasting station at an elevation higher than had been occupied by such a station in the United States. It transmitted the proceedings of a gathering of Boy Scout officials, including speeches by Dan Beard, James E. West and other famous men. Keep working at radio and some day you too may land an interesting job—as these two youngsters did.

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A Scout Radio Shack in the Trees

A BOY scout in Gowanda, New York, decided a while ago that so long as he had to put his aerial up in the trees, he might as well build his radio shack there also.

The first step was to select three trees near enough together to support the structure. When these were found, he started up one of them, nailing on cleats as he climbed. With the cleats forming a ladder forty feet high, it was easy to hoist poles to bridge the space between the trees and form beams to support the shack. The ends lay in convenient crotches or were lashed and spiked in place and braced underneath by brackets.

The floor was made large enough to extend beyond the cabin and form a porch. The house was framed of two-by-four joists and boarded; the gable roof was covered with a single layer of roofing paper.

On account of the foliage, insulated wire was needed for the antenna. A wire attached to a nail driven into one of the trees might have served, but whether the trick of using a tree as an aerial was known to the scout or not is not reported. A ground connection also could be made through a tree although it would not be excellent.

Radio under such conditions has several advantages. One of them is that only an agile parent can come and get the operator when it is time for him to go to bed.

A RADIO SHACK IN THE TREES

This young boy scout in Gowanda, N. Y. reduced interference from both neighborly buildings as well as from insistent parents by building this comfortable little house forty feet above ground.

Get Your Money's Worth of local and distant programs

Use a Beldenamel Aerial with your new set

DISTANCE! That is the real test of your new set.

But don't forget that you cannot get the finest results unless you have a good aerial. Many good sets are permanently crippled because set owners mistakenly believe that corroded, soot-covered aerials are "good enough."

Ask your nearest radio dealer for a Beldenamel Aerial

A corroded aerial reduces the volume and distance of even the finest radio set. That is why a Beldenamel Aerial should always be used. Each strand of a Beldenamel Aerial is coated with weather-proof, fume-proof baked enamel. Even after years of service, a Beldenamel Aerial is still as good as new. It cannot corrode. It always assures maximum distance and greatest volume.

Belden Manufacturing Company
2316A South Western Avenue, Chicago, Illinois

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Perfect Tone Quality
at low cost

The best tone quality can be enjoyed even with an inexpensive set if resistance coupled amplification is employed. It is the one sure method of getting even amplification of all tones, and it has the added advantage of consuming less "B" battery current than other methods of audio amplification.

Micadon 640 A is the Dubilier Condenser to use for this unit. Designed and patented by Dubilier it provides unvarying capacity with the lowest dielectric loss—so essential for the true reproduction of sound. Used with the silent Dubilier Metaleak, Micadon 640 A will give you the foundation for an amplifier unit with all the tone quality found in the best radio sets.

If you are interested in building a resistance coupled amplifier send ten cents in stamps or coin for our 32-page booklet "Seventeen Ways to Improve Your Set." It gives diagrams and specifications and contains hints for set builders that only experts formerly knew.

Dubilier
CONDENSER AND RADIO CORPORATION
4377 Bronx Blvd., New York, N. Y.

A Radio Receiver in a Scout Hat

THE first prize in one of the contests at a recent radio show was won by a receiver in a Boy Scout hat. This novel and practical idea can be worked out in a number of ways.

The most difficult part to manage is the phones. These should be as light and as thin as possible. A single phone may be used, but the lightest one obtainable is heavy enough to throw the hat off balance unless parts of equal weight are suspended from the opposite side.

A head-band would be in the way inside a hat. The phone cords are attached to the sweat-band so that the phones hang loosely over the ears, where they are pressed into closer contact by the hands. They can be hung slightly above the correct position and then drawn down tightly by an elastic band passing under the chin. This leaves the hands free.

The phones and a crystal detector are all that are necessary for picking up local stations after contact is made with an antenna and a ground. When galena is used it may be necessary to mount the detector with long wires so that it can be taken from the hat and held in the hand for adjustment. Or the phones may be mounted so that they can be removed from the hat and the hat placed on the ground while the receiver is in use for convenience in operation.

Some crystals requiring heavier contact may be sealed in so that they will function for a long time without readjustment. Cat whiskers have been made with a brush end that made many contacts with the crystal, and it is claimed that these can be used indefinitely without readjustment unless the whole brush loses contact. A small, flat detector that will fit into the crown of the hat and hold its sensitive adjustment might be designed by any ingenious radio amateur. The crystal must be protected so that the sensitive surface will not touch the hair, which contains enough oil to coat the surface and destroy its sensitivity.

A receiver without a tuner will not be selective, of course. A tuner that will fit into the crown of a Scout hat, or any hat of similar type, may be made from a spiderweb coil and a book-type condenser. The latter may be made of two metal plates, fastened together at the ends but insulated from each other, and operated by a screw or other device that will open and close the free ends like pages of a book.

The plates may be cut to fit the crown of the hat; one may be attached to the felt, the other left free to open and close. The screw or other control may project through the crown where it can be reached by the hand without removing the hat.

The plates must be protected so that

A RADIO RECEIVING SET IN A BOY SCOUT HAT

The headphones are hung from the sweat-band; the tuner and crystal detector are mounted in the peak of the hat.

they will not touch anything; a simple method is to enclose them in a piece of a rubber bathing cap, which will stretch enough to permit the maximum separation and also serve to draw the plates together again. The lightest and thinnest, though not the most durable, condenser may be made of sheets of tin foil, wax paper and stiff cardboard. The tin foil may be attached to the cardboard covers of the book and strips of wax paper fastened in such positions as to prevent the two sheets of tinfoil from touching each other. The spiderweb coil may be attached to the outside of one of the covers, with one end fastened to one sheet of tinfoil and the other end to the other sheet, thus forming a shunt connection.

The tuning range of this tuner will depend upon the inductance of the coil and the capacity of the condenser. The measurement of the inductance in a coil is difficult. It is better to buy one to cover a given range of wavelengths or wind one of similar dimensions. A beginner who has a little knowledge of mathematics may be able to calculate the capacity of a home-made condenser approximately by using this formula:

Capacity, in microfarads, equals the area of the plates in centimeters, squared, multiplied by the dielectric constant, divided by 11,309,760 times the distance in centimeters between the plates.

The dielectric constant of air, which is the dielectric that separates the plates in this type of condenser, is 1, so the above formula as applied to this case is simplified to squaring the area of the plates in centimeters and dividing as stated above.

Some may prefer to use a fixed condenser and a variable inductance coil. A fixed condenser is even easier to construct, the tinfoil being laid between sheets of wax paper, and it can be folded to any convenient size. A tapped coil with a switch involves much more work than one without taps, but many have been made by beginners with satisfactory results.

Wires for the antenna and ground connection may be coiled around the outside of the hat after they are connected with the apparatus inside through the ventilating holes in the crown. Fifty feet of small wire does not add much to the weight of the hat. The free end of the wire may be attached to a stone and thrown over the limb of a tree to raise the antenna to the desired height. The end of the ground wire may be dropped into a stream of water, attached to a nail driven into a tree, or connected with any water pipe or other metal that enters wet soil.

Having phones and tuner installed in his hat, a Scout might construct an adapter that would enable him to place a small detector tube in his flashlight and light the filament with its batteries.

"I have made 6 of your 3 ft. Cone Speakers and have never heard a speaker so wonderful. I have had no trouble in making them."
—K. T., Chicago

"I wish to congratulate you on your loud speaker. The results obtained either on a two peanut tube set, or a 10 tube Super 10 with four stages of audio are simply wonderful."
—R. B. T., Montreal

"I am surprised and gratified in the way it works. It has a beautiful tone and does everything that you claimed for it in your advertisement."—R. T. K., Pontiac.

Later: *"I have been using the cone every day and it works better than ever. In my last letter I was careful not to brag too much; could have said a lot more."*

"Is in every way satisfactory and is all, in fact more, than I hoped for."—J. N. H., Gary.

"It is the finest speaker that I ever owned or heard."—W. A. R., Port Huron.

"I cannot help but write to you and express my appreciation of the wonderful tone quality and purity of this most excellent loud speaker."
—G. H., Cleveland

"Properly constructed the unit produces a reproduced tone quality that is without exception remarkable."—Milo Gurney, Technical Ed., Radio Digest, Chicago.

"Mr. Gurney has recommended it as comparable only with the 3 ft. ..... I would like to build two of these speakers for the use of my parents and myself."—E. E. P.

"Is the best I have heard; the 3 ft. cone cannot be beat at any price."
—H. M. L., Galesburg

"We put the speakers together and they worked fine. Everyone is enthusiastic about them."—Volney Hurd, Radio Ed., Christian Science Monitor, Boston.

Build Your Own 3-foot Cone Speaker

—save four-fifths of the retail cost

In one evening you can build as fine a giant 3 ft. Cone Speaker as you can buy if you use *genuine* PENN parts. You save 4-5 the retail cost of a factory-built 3 ft. Cone Speaker by the simple, easy-to-follow directions.

Radio's greatest technical editors endorse the PENN Unit and other PENN parts—L. C. Cockaday, Milo Gurney, Volney Hurd, Robt. Casey and many others—because the PENN Unit has proved itself the finest, most sensitive, most powerful and sturdiest for the home constructor.

The Penn C. S. Unit, heart of the 3 ft. Cone Speaker, has a supercharged, 16 oz. cyanide hardened steel magnet, udalyted, which adds 50% to magnetic life. Unit is adjustable to output of set with which it is used; so sensitive it operates with any set able to work a loud speaker; so powerful it takes all the volume the tubes will pass; reproduces perfectly all audible frequencies. Guaranteed electrically and mechanically perfect.

Parts Complete

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remarkable speaker reproduces all the tones of every instrument in an entire symphony orchestra, from the low rumble of the kettle drum to the piping note of the piccolo. Equally wonderful on singing and speaking.

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Marvelous Tone Quality

With a PENN 3 ft. Cone Speaker you will really enjoy radio reception. This

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Alhambra FONOTEX is *not* paper but a patented product made by a patented process exclusively for cone speaker cones.

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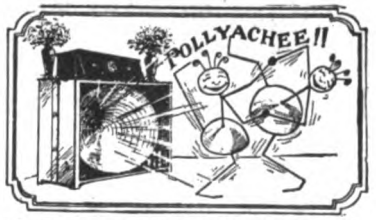

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With this THREE FOOT CONE SPEAKER you hear ***all*** the tones. It brings out the true depth and beauty of orchestral and instrumental music. Can be operated softly for living room music or full volume for dancing, and without trace of distortion.
Kit includes famous "ENSCO" cone unit, the only direct drive, distortionless unit for large cones; Alhambra Fonotex for big cone, with brass apex, two Blue Prints showing cabinet, stand, or roll-type construction. All necessary instructions for assembling.
Buy this wonderful speaker under our absolute guarantee. ***Your money back*** if you are not convinced that it is the finest reproducing medium. It works on any set, with ordinary Tubes or with Power Output.

ORDER COUPON — SEND NO MONEY

Write your name plainly as indicated below, then mail and complete kit will be forwarded to you. Just pay postman $10.00 upon delivery.

Name.....

Address.....

ENGINEERS' SERVICE CO.
25 CHURCH ST. Desk Z NEW YORK CITY

A small "B" battery may be carried in the pocket or haversack, or in a special pouch hung on the belt.

The uses of receivers carried in the hat are numerous. A Scout troop with a portable transmitter, and with its Scouts all provided with these receivers, could work as a unit even though the patrols or individual Scouts were several miles apart. Interesting tests and games may be arranged that will test thoroughly a Scout's ability to read the International Morse code, which all must learn before they wear the first-class badge.

Messenger service such as Scouts perform at many gatherings could be expedited by these peripatetic receiving stations, and when storms, floods or earthquakes crippled local wire service the Scouts could render even more efficient aid than they have given so often without the use of radio.

How to Dodge Interference from Electric Wires

A RADIO amateur recently was confronted by the problem of erecting an antenna where it seemed likely to pick up more interference from high-tension wires than useful energy from radio stations.

Along the north and east sides of his lot ran many wires, some carrying 4700-volt current; several of them cut across a corner, making a 100-foot stretch running from southeast to northwest. The house lighting mains came in from the northeast, and a line ran underground down the middle of the lot to a studio where a receiver was to be installed to supplement the one in the house. Every compass direction was covered by a wire that might cause interference, and across the street was a transformer station in which the current for the entire community was stepped down from 4700 to 2300 volts and distributed to more mains running in all directions.

The amateur placed a pulley sixty-five feet up in a tree at the middle of the west line of his lot. Through this he rove sash cord with which to hoist and lower the outer ends of the antennas that ran down to the house and studio. The drop from the tree to the points where the receivers were located was sufficient so that the lines of the two aerials cut the lines of all the surrounding wires at angles that reduced inductive effects to the minimum. When the receivers were tested, no hum from the wires or the transformers could be heard.

There is a suggestion in this experience for those who cannot avoid paralleling high tension wires if they erect flat top antennas. Place one end of the antenna high and the other low. Or a vertical antenna that will pick up little interference from horizontal wires.

Why Better Parts Sometimes Get Poorer Results

AN ENGINEER, speaking at a meeting of one of the important radio organizations, stated recently that radio users often complained that they had replaced the amplifying transformers in their sets with transformers of better design and construction but had failed to obtain better results. In some cases the results were much worse, although the new transformers were unquestionably superior to the old ones.

He explained that new transformers, installed without regard to the characteristics of the tubes used, often overload the tubes. Such overloading causes distortion and often shortens the life of the vacuum tubes.

The characteristics of different tubes vary greatly. The filament of a WD-11 type tube might be wrecked by a load that the new tubes designed for use in the last stage of low-frequency amplification could carry with ease. A competent engineer, in designing a receiving set, takes into consideration the characteristics of the tubes to be employed. He designs the set for a certain number of tubes of specified characteristics and designs his circuits so that each tube shall have a certain input and specified voltages on the filament, the grid and the plate, together with a load that shall not exceed a specified maximum. There may be several kinds of tubes that can be used in the set interchangeably, but the characteristics must not vary beyond certain limits, nor the load be increased, or the results will suffer.

He puts into the set inductance coils, condensers, rheostats, transformers and other parts that will work well together with the tubes recommended. Knowing definitely the characteristics of all these parts, he can tell in advance what results the set will deliver when properly installed and operated according to directions under average conditions.

The set goes into a home. It gives satisfaction up to a certain point, but no radio user ever got as much out of any set as he would like to. Some of us try to get more out of the air than there is in it. Some neighbor gets greater distance or volume, with a set in which there are transformers of a different type. They are widely advertised and highly recommended. So the user buys new transformers and installs them. They do not work as they do in the neighbors' set.

Then the trouble begins.

The manufacturer of the transformers probably would not recommend them himself for the place if he knew all the conditions. The local dealer may know that they are better in material and workmanship than the old ones and recommend them honestly, but without knowing what the radio engineer does who designed the set.

It is not often that a set, however

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good it may be, will come through an overhauling by an amateur and deliver as good results afterward. The radio user should refresh his memory concerning the maker's guarantee, if there was one. If the set is not delivering results as guaranteed, the manufacturer should be notified, directly or through the local dealer. His instructions should be followed and he should be held accountable for the results. When the purchaser tampers with a set he automatically releases the manufacturer from much of the responsibility that honest concerns carry cheerfully as long as their goods are used according to directions.

Even as simple a piece of apparatus as a rheostat must be carefully tested to see that it performs satisfactorily.

How Rheostats Are Tested

EVERY piece of radio apparatus placed on the market by a reliable manufacturer is tested before it leaves his factory.

The man in the picture above is testing rheostats. Each one is connected in series with a battery and a meter; unless it proves that it can increase or decrease the current evenly as the knob is turned, it is rejected.

The rheostat being tested is of the pressure type, the resistance material being a mixture of powdered carbon and metal. This type is capable of very fine adjustment, probably finer than can be obtained with a wire rheostat having a vernier attachment. Twelve turns of the knob are required to cover the entire range of adjustment.

The usuable portion of the range is smooth and continuous and gives a micrometer adjustment.

375,000 Miles of Wire For "Wireless"

A RADIO amateur who works in a factory where magnet wire and all small sizes for radio work are manufactured figured out how far the wire would reach that was made by the concern in one day. He found that an average day's output would reach fifteen times around the earth, the length of wire being approximately 375,000 miles.

PRECISION OCTAFORM COIL

A new type of inductance used in the Cockaday LC-26 Receiver. The only coil that can be used in this set. Price $5.50.

COCKADAY COIL $5.50
(New Octaform Base)

The fact that this coil was used in the 4-Circuit Tuner as designed by Mr. Cockaday, is significant recognition of the accuracy and efficiency of Precision Coils.

PRECISION

TAPPED CHOKE No. 380

This coil has been designed for those who desire a tapped choke. Slotted form winding lowers capacity. Price $1.75.

Dealers Write for Catalog

The UNIVALVE RECEIVER

A single tube set giving loud-speaker volume.
A new development incorporating the little known shunt reflex.
Every part fully guaranteed.

COMPLETE LIST OF PARTS

2—Hammarlund Auto-couplers	$7.00
2—Cardwell Taper Plate Variable Condensers, type 169-E, .00035 mfd. equipped with 2 Cornell Etched Vernier Dials	9.50
1—Karas Harmonik Low-Frequency Transformer	3.00
1—Thordarson Low-Frequency Transformer, 2-1 Ratio	7.00
1—Carter Battery switch	5.00
1—Amperite No. 1 A	.65
1—Aerovox Mica Fixed Condenser with Grid-Leak Clips, .00025 mfd.	1.10
1—Aerovox Mica Fixed Condenser, .0001 mfd.	.40
1—Aerovox Mica Fixed Condenser, .0005 mfd.	$ .30
1—Daven Grid-Leak, 4 megohms	.30
1—Carter Small Single-Circuit Jack	.25
1—Bakelite Front Panel, 7 by 15 by 3/16 inches	.25
1—Hardwood Sub-base, 7 by 14 by ½ inch	2.50
1—Bakelite Binding-Post Strip, 1 by 9 by 3/16 in.	.50
7—Eby Binding Posts	.30
2—Small Brass Brackets	1.05
1—Benjamin Vibrationless Socket	.10
	.75
	$39.95
1—Emerson Multivalve Tube	6.50
POPULAR RADIO Blueprints	1.00

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ESSENTIAL KIT

1 Set of Precision "N" Coils	$6.00
1 Prec. Var. Condenser type "N" .00023 Mfd. Cap	3.50
2 X-L Variodensers, type G-10	3.00
1 7x14x3/16 drilled panel	3.50
1 7x13½ baseboard	.75
Including diagrams, etc.	$16.75

PARTS YOU WILL NEED BUT MAY HAVE

1 Electrad Royalty Resistance, 500,000 ohms	$1.50
1 Electrad Fil. Switch	.40
1 Electrad Double Mtg. with .01 fixed Cond	1.75
1 Electrad Resistor .1 meg.	.60
1 Electrad Resistor .5 meg.	.60
1 Amperite 6 volt ¼ amp.	1.10
1 Amperite 6 volt ½ amp.	1.10
1 Electrad gridleak 5 meg.	.60
2 Samson transformers	10.00
1 Silver Marshall Dial	2.50
8 Fahnestock clips	.15
2 Pacent Sockets @ 65c	1.30
1 Electrad .00025 grid cond. with mtg	.40
Including diagrams, etc.	$22.00
Tubes you will need	
1 Cleartron Multi-valve	6.50
1 CTX-112 or Equiv.	4.00
Total, including tubes	$49.25

PRECISION COIL CO., INC., 209 Centre St., New York City
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Your Radio Problems Solved

POPULAR RADIO maintains for the benefit of its readers a Technical Service Bureau and Laboratory, under the personal supervision of Laurence M. Cockaday which will, without charge, answer by personal letter any question, problem or request for information submitted by a subscriber. This service is, however, also available to readers, other than subscribers, at the very nominal rate of $1.00 the inquiry.

In writing please confine your questions to one general subject, writing on one side of the paper only, and enclose a self-addressed and stamped envelope.

It is possible that your individual problem has been covered in an issue of POPULAR RADIO, and so as an aid to you we endeavor to keep a supply of back numbers in stock. The condensed index below gives a few of the subjects that have appeared recently, look this list over and if the information you want is covered, we will be pleased to supply back numbers at 35c. a copy.

March, 1926
—Why and How the Milliammeter Increases the Efficiency of Your Set.
—What "Inductance" Really Is.
—List of Broadcast Stations in the U. S.
—How to Build the S-C Receiver for Short and Long Waves.
April, 1926
—How to Get an Operator's "Ticket."
—What a Straight-line Frequency Condenser Really Is.
—How to Build a Power-pack Amplifier.
—The New "Crystal Pilot"
—How to Build and Operate a Low-Power Transmitter.
—The POPULAR RADIO Medal for Conspicuous Service.
May, 1926
—How to Draw Up Your Own "Tuning Graphs."
—How to Build the Improved Raytheon Power-pack.
—How to Build an Antenna Mast for $15.00.
—Fifteen Ways to Reduce Static.
—Do Your Coils Broadcast?
June, 1926
—How to Build the New Home Receiver.
—How to Put Up a Good Outdoor Antenna.
—How to Get the Most Out of Your Ready-made Receiver.
—Audio-frequency Amplification. How to Get it Without Distortion.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.
July, 1926
—How to Get the Best Reception in Summer.
—The Best Crystal Set for $13.00.
—How to Build the Newest Portable "Town and Country" Receiver.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.
—How to Get the Most Out of Your S-C Receiver.
August, 1926
—A New Method of Using Harmonics for Determining Frequencies.
—POPULAR RADIO Circuits.
—How to Build the Improved Browning-Drake Receiver.
—How to Pick Out a Loudspeaker.
—How to Get the Most Out of Your "Town and Country" Receiver.
—Three Vacuum Tubes in One.
September, 1926
—Foretelling Radio Reception from the Weather Map.
—How to Build an Impedance-coupled Amplifier.
—A Radiant Crystal Pilot.
—POPULAR RADIO Circuits.
—How to Simplify Your Set with Automatic Filament Controls.
—Inside Information on New Radio Receivers.
—How to Wire Your House for Radio.
October, 1926
—How to Build the New LC-27 Receiver
—The Radio Road Hog
—POPULAR RADIO Circuits
—Sets That Earn Incomes.
—Inside Information on New Radio Receivers.
—Why Signals Fade.
November, 1926
—How to Build the LC-Senior Power-Pack.
—Waves and Wavelengths.
—POPULAR RADIO Circuits.
—How to Select Your Radio Parts.
—How to Patent Your Radio Inventions.
—How to Solder.
December, 1926
—Uncle Sam's New Short-Wave Net.
—How Circuit Resistance Affects Selectivity.
—POPULAR RADIO Circuits
—How to Build the LC-Intermediate Power Pack.
—Inside Information on New Radio Receivers.
January, 1927
—How to Build the New KH-27 Receiver.
—To Start and Stop Your Set Automatically.
—POPULAR RADIO Circuits.
—The Quack Doctors of Radio.
—How to Build the LC Junior Power-pack.
February, 1927
—The Coming of the "Radio University."
—How to Get Quality Amplification.
—How to Build and Use a Portable Test-Board.
—How to Assemble the All-Amax Senior Three-tube Reflex Receiver.
—What's New In Radio.

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FREE PARTS
for the new
Univalve Receiver

If you want to build your own set, here is your opportunity to secure FREE all the parts you need for this "Univalve Receiver." Call on all your radio friends, and on anyone who has a set and tell them of the many special features of POPULAR RADIO.

These liberal offers will make it possible for you to secure an order from every one you call upon. For each subscription with remittance you send us you will receive credits as per the following scale:

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6	"	"	1.50	"	25	"
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24	"	"	5.00	"	75	"

Send us the full amount collected with names and addresses of subscribers and tell us the parts your credits entitle you to and we will send them to you. If the subscriptions you secure do not give you enough credits for the parts you want, we will allow you to purchase credits at the rate of 3 cents each. *Example:* With (7) seven 1-year subscriptions (350 credits) and 90 cents additional in cash you may have 2 Cardwell Taper Plate Variable Condensers, for which you need 380 credits.

If the parts you want are not listed in this advertisement, we are prepared to supply them. Let us know what you want and we will tell you how many credits you will need.

On page 313 are described POPULAR RADIO'S Simplified Blueprints. You can have any set of prints you want for only 40 credits. You may also secure a copy of "How to Build Your Radio Receiver" described on page 310 for 60 credits.

CREDITS Needed for Parts Required for the new "UNIVALVE RECEIVER"

(Described and illustrated in this issue of POPULAR RADIO).

Quantity Item	Credits
2—Hammarlund Autocouplers	280
2—Cardwell Taper Plate Variable Condensers, type 169-E, .00035 mfd. Equipped with 2 Cornell Etched Vernier Dials	360
1—Karas Harmonik Low-Frequency Transformer	120
1—Thordarson Low-frequency Transformer, 2-1 Radio	280
1—Any Approved Battery Switch (Carter Switch Illustrated)	200
1—Any Approved Automatic Filament Control .25 amp. (Amperite Illustrated)	26
1—Any Approved Mica Fixed Condenser with Grid-leak Clips, .00025 mfd. (Elcetrad Condenser Illustrated)	44
1—Any Approved Mica Fixed Condenser, .0001 mfd. (Electrad Condenser Illustrated)	16
1—Any Approved Mica Fixed Condenser, .0005 mfd. (Electrad Condenser Illustrated)	12
1—Any Approved Grid-Leak, 4 megohms (Polymet Grid-leak Illustrated)	12
1—Any Approved Small Single-Circuit Jack, (Electrad Jack Illustrated)	10
1—Bakelite Front Panel, 7 x 15 x 3/16 Inch	10
1—Hardwood Sub-base, 7 x 14 x ¾ Inch	100
1—Bakelite Binding-post Strip, 1 x 9 x 3/16 Inch	20
7—Any Approved Binding Posts, marked Ant., Grnd., A Minus, A Plus, B Minus, B Amp. Plus, B Amp. Plus, respectively (Eby Binding Posts Illustrated)	12
2—Small Brass Brackets	42
1—Benjamin Vibrationless Socket	4
	30
Total	1598

Write for List of Free Parts for Other Popular Radio Receivers

POPULAR RADIO
Department 31
627 West 43d St. New York City

The YES *and* NO MAN

FRANCIS B.D.—*Edward Smalle* and *G. Underhill Macy* make up the team of the Imperial Imps from WJZ. * * * How do we get our dope? Oh, we sniff around here and there. * * * *Vincent Lopez* had his 29th birthday on the 30th of December, 1926. * * * How old are we? Well, you'd go bust buying candles for our birthday cake—we can tell you that much!

RED HOT DADDY.—Why don't we have more poetry on the air? Well, we've not looked upon the absence of poetry as a shortcoming of the radio; like red pepper and synthethic gin, a little of it goes a long way. * * * There was a time when NTG of WHN "poemed" every night, but he seems to have recovered from that and the doctor says he's doing nicely now.

JAMES V.L.—Only a few of the announcers send out autographed photographs; we do not have a list of them. * * * Perhaps, if you *insisted*, you might convince any announcer that he really owed you a portrait. * * * We know of harder things to do; convincing the average announcer that he should *not* send you a picture of himself, for instance.

JAKE AND BILL.—Yes, *Keith McLeod* does actually play the vibraphone in the WJZ concerts; he has recently taken this up as a hobby, although 'tis said his landlady is giving him nasty looks in the hall.

MAC McL.—We don't know why *Joseph Knecht* left the Waldorf-Astoria; perhaps his contract with that house ran out.

BONES.—Will we ask *Milton Cross* personally to lift that "sad, gray intonation" from his voice? * * * While it is true that *Cross* is a trifle sanctimonious, it is his natural way, and an attempt to change his announcing would prove fatal. There are too darn many announcers now trying to be something other than they are. * * * *Leslie Adams* is the announcer of KFI. Yes, he's young—32 to be exact.

JIMMY.—Yes, *Charles D. Isaacson*, the program director of WRNY, is the author of "Face to Face With Great Musicians." * * * *Lytton Spaulding* is the KTAB announcer whom you have in mind; he's a young fellow, just out of college. I can't express an opinion concerning his talk; our receiving contraption will not work that station. * * * Still, we have many, many nice announcer boys to listen to, so we're not sorry. * * * Don't tell us that you don't like sopranos! Heavens, can you *imagine* that?

DR. B.L.—We're sorry, but we don't happen to know of a station that would be interested in a lecture on "Natural Results With Herb Cures," but perhaps, if you had this set to music, you might get WHN to broadcast it.

J.H.B.—There is no telling what will eventually become of *Graham MacNamee;* like all good men, he'll probably wind up in the Hall of Fame. * * * Have we ever broadcast? Yes, from WOR and WGR, long, *long* ago.

GUM DROPS.—*Kenneth Fickett* is the announcer and studio director of WGR, Buffalo. * * * Yes, he has a *very* pleasant voice; to our way of thinking, he's one of the best announcers on the air; he's certainly not troubled with the Napoleon complex.

TEDDY.—What happened to *Lewis Reed* the old WJZ announcer? Oh, he's up there with WCPH, that big, powerful percolator at 57th Street, New York, where they advertise cheese and darning needles.

LITTLE MAN.—*Kenneth Ormiston* has never announced from a New York studio; during his recent visit to New York he was not in a broadcasting mood. * * * So you thought *Francis Alda* was disappointing? * * * Well, radio *does* treat the big stars rather harshly at times, doesn't it?

D.H.C.—*Judge, Jr.* does not broadcast any more from WJZ. * * * The program of the Walla Walla Meat and Storage is broadcast from KOWW. * * * *Ralph Wilkins* was the tenor you had in mind; he's gone West.

ALBERT SPALDING.—*Rutherford Hayner* is program manager and announcer at station WHAZ. * * * No, he's not a student at *Rensselaer Polytechnic.* * * * This office is *not* a Bureau of Missing Announcers. * * * *Edward B. Huseig* is still a member of the WJZ staff; he might have been a very good announcer had he not been smitten with *Brokenshire's* style and tried to mimic it.

CARLTON L.—*Myer Davis* is now musical director of the Waldorf-Astoria in N. Y. * * * So you'd like to hear a good concert by a whiskey tenor? Well, we've had everything but whiskey tenors on the air and personally we'd like to hear "Sweet Adeline" as only a partly stewed coal wagon driver can do it.

HAROLD B.H.—*Percy Boyd* is the manager of KOKA studio; write to him direct. * * * How to invent a fresh announcer exterminator? Gosh, we wish we knew!

HARRY HOWE.—*Mr. Schenk*, the new announcer at WEAF, was formerly a baritone with *Roxy*, and he hails from Mt. Vernon, N. Y. He is a graduate of the Naval Academy. 'Tis said that he is only 25 years old. * * * *Fred Smith* is the chief announcer of WLW and he seems to be satisfied with his work. * * * We have never heard of the *Bolonga Boys*, and their sausage songs; we have, however, heard the *3-in-One Oilers* and their oil cans.

DAVIDSON.—*Kalin Hagen*, the WGY announcer, wrote "Gentlemen Prefer Blinds;" glad you liked it. * * * Yes, *Hagen* is an old timer; he's been announcing at WGY since 1922. He's one of the very few ideal announcers and good announcers are extremely scarce. * * * Sorry we can't help you get a job in a studio; besides, if you have a good job, stick to it; the woods are full of radio-struck people.

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JEROME S.—*Charles Wellman* is the announcer of KFWB; he has a wife and family—and a very good publicity man. No *Wellman* has never been in the movies. * * * If we mention a "certain" announcer again in our "frightfully sarcastic way" you are going to send us poisoned candy, eh? Well, go ahead. If we receive any candy from a stranger we will forward it to the announcer in question, so there!

B.B.V.—You are all wrong about *N.T.G.* * * * He was *not* the model for the Glostoria advertisement; however, we understand that big throat lozenge people are anxious to make a deal with him.* * * If you ever heard him roar through "Boots" you would know why.

A.W.C.—We are sorry to learn that *Vincent Lopez* makes you so mad in rhyming "radio" with "lady-o" that you have to beat your wife.* * * Try *Ben Bernie.*

DR. L. O. P.—*Harry Richman* is not broadcasting now.* * * He *is* a funny fellow and we miss him, too.

V.P.—Send your crochet needle to *Mr. Norman Brokenshire,* at WPCH, New York City.* * * He will probably appreciate your poem "An Ode to Norm" very much.

R.W.R.—*Phillips Carlin* lives in New York City; he is the manager of WEAF's studio which, of course, makes him *Mr. McNamee's* boss.

G.G.—We don't know what has happened to *May Breen;* she is probably writing songs and doing her house cleaning. We also think that she is the best banjoist on the air.* * * Yes, she is married and has a very beautiful daughter about ten years old.

N.V.N.—*Milton Cross* lives in Brooklyn, N. Y., and he does a great deal of professional singing outside the studio.* * * Yes, we think that he is a very resourceful announcer; as a matter of fact, we think that he is best announcer in this big country of ours, although he is rather verbose at times.

A.L.M.—And who told you that *Graham McNamee* had a son at Yale? * * * You are wrong; *McNamee* was a voice instructor before he began to broadcast.

R.H.—You are wrong about the microphone at that, Newark, N. J. station. It is an oil can and *not* a hot-water bottle.* * * That funny noise that you hear may be the handful of dried beans that were unwittingly left in the big vacuum tubes before they were sealed up, and the hissing noise you heard was probably the valve on the steam radiator.* * * No, the announcer is not troubled with asthma.

B.N.B.—No, the broadcasting equipment of WRNY is not located under *Ben Bernies's* bed on the 11th floor of the hotel Roosevelt.* * * It is a standard Western Electric station troubled with shortness of breath. Yes, the location was very bad.

BIG BEN.—You lose your bet; *MacNamee* announced both the Army and Navy games. * * * *Mac* lives on Riverside Drive, New York, and comes from Minnesota or somé such place.

$17.50 complete

$12.50 complete

The Lowest Priced *Quality* "B" Eliminator

Livermore Falls, Maine. Have been using your Eliminator for a year and well satisfied with it as it gives good results and is free from any hum. ELMER A. RIGGS.

Duluth, Minn. Your Eliminator has given me wonderful continuous service for the past year. F. A. LOHMER.

St. Louis, Mo. Your Eliminator is wonderful. I am recommending it to all my patients as I think it a wonderful value. DR. A. C. BURIAN.

Columbus, Ohio. Your Eliminator has been in service for a year and I am very well satisfied with it. LEO C. SPRAGUE.

San Jose, Calif. Have had your Eliminator for a year and it has given perfect satisfaction. W. S. SAWDEY.

Cleveland, Ohio. After nineteen months of service my Ferbend Eliminator is still giving excellent results and has stood up against much higher priced outfits. R. ST. BARHOFF.

Beaver, Penn. I have been using your Eliminator for a year now and have wonderful results with it. R. L. McCULLOUGH.

Corsicana, Texas. One year ago I bought one of your Eliminators and have been very well pleased with it. DR. HUBERT B. LOVE.

Aledo, Ill. The Eliminator I bought from you a year ago works fine. WILLARD RUSE.

The moment you see the good Ferbend "B" Eliminator you understand why during its first two years of successful service it has made nearly 50,000 friends. "Singular Value" is written all over this fine instrument.

Outstanding Quality, however, is confirmed only through proof of lasting good performance—so we ask you to read the interesting endorsements reproduced here. They are only a few out of thousands—but actually your best means of verifying the information we give you.

How can we produce a Quality Instrument at a price so spectacular? Because we are pioneer specialists in the manufacture of "B" Eliminators—because every component part is designed, made and assembled under one roof—because our overhead is many times lower.

The Original Ferbend "B" Eliminator operates direct from your Electric Light Socket on 110-120 volt A. C. Lighting Circuit. Delivers up to 100 volts. Price $12.50. The electrolytic method combined with full wave rectification gives results equal or superior to those obtained by any other method.

The New Ferbend High Voltage Model for extremely large sets and all sets using power tubes. Delivers up to 180 volts. One Control adjusts voltages on all taps. Price $17.50.

Equal to Any—at a cost less than half! Sooner or later you will purchase a "B" Eliminator. Why pay more?

Money-Back Guarantee

See Your Dealer—or Send Direct

Shipment made direct on receipt of price, or C.O.D. if preferred. Use for 10 days to convince yourself—if unsatisfactory write us within that time and purchase price will be refunded. Send Coupon TODAY.

FERBEND ELECTRIC COMPANY
419 West Superior Street **Chicago, Illinois**

FERBEND "B" ELIMINATOR

Approved and passed by the rigid Laboratory Tests of the two foremost Radio Laboratories in America—Radio News and Popular Radio.

FERBEND ELECTRIC CO.
419 W. Superior St., Chicago, Ill.
[] Send $12.50 model.
[] Send $17.50 model.
[] Send at once. Payment enclosed.
[] Send C. O. D. [] Send Literature.

Name .....

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The
POPULAR RADIO
Atlas *and* Log

will give you a list of all the NEW Broadcasting Stations with wavelengths and other necessary information

A Complete Atlas and Station Log

The "POPULAR RADIO International Radio Atlas and Log" will supply you with full information regarding broadcasting stations of the United States and Canada.

This most useful and practical Atlas consists of 16 pages, size 12" x 15", printed on good paper, from clear type in two colors and contains a complete series of double page maps, including—The World—The United States—Canada—North and South America, showing location of principal broadcasting, leading commercial and governmental radio stations.

SPECIAL FREE OFFER

You may have a copy of the "POPULAR RADIO International Radio Atlas and Log" free, with POPULAR RADIO for (8) eight months.

For Only $2.00

Pin $2.00 in bills to the coupon below.

If you are a subscriber to POPULAR RADIO your subscription will be extended eight months.

Date_____

POPULAR RADIO, Dept. 32A
627 West 43rd St., New York City.

Enclosed is my remittance of $2.00 for which you are to enter my subscription (extend my subscription) for (8) eight months for POPULAR RADIO and send FREE a copy of the "POPULAR RADIO International Radio Atlas and Log."

Name_____

Address_____

City_____ State_____

BROADCASTS

CONDUCTED BY CHARLES L. REESE, JR.

The First Opera Premiere by Radio

FOR what is believed to be the first time, an opera premiere was performed exclusively for the benefit of the radio audience when "Hassan der Chwaermer" a new work by Wilhelm Kienzl was broadcast from a Vienna station. Rather than delay the production for the tremendously expensive stage premiere, Kienzl allowed the opera to be broadcast, thus subjecting it to the severest test a new opera can meet, for the music must stand entirely on its own merits without the aid of scenery or costume.

* *

A Church Protests Church Propaganda

WHAT is believed to be the first definite action taken by a religious body against the mass of propaganda of a religious nature that now fills the air is the circular that has recently been sent out to all members of the Christian Science Church, formally disapproving the anti-Catholic and anti-Jewish talks that they say are being broadcast from a New York station, WHAP, by a group of persons using the term "Christian Science" without authority from the governing board of the Church.

* *

A Laughing Contest that Was a WOW

NEARLY a solid hour of laughs offered by more than 100 persons were broadcast recently in the first radio laughing contest, from station WOW at Omaha, Nebraska. Each contestant was allowed 30 seconds to charm the radio audience; the judges picked the "champion laugher" from the receivers in their own homes.

* *

Will the Courts Clear the Air?

A NEW way out of the present chaos in radio broadcasting and one that jeopardizes the existence of hundreds of new stations hangs on the latest decision in the WGN-WGES case in Chicago. In that decision Judge Wilson decided that under common law, WGN, having broadcast first on its wavelength, has the right to a free and unobstructed ether channel. Already WHN, a New York station has moved for an injunction to prevent WRNY from interfering with its broadcasts by transmitting on a channel too near its own. Although the offending station in the first case was only ordered not to interfere, this order would have the effect of forcing most new stations entirely off the air. With approximately 700 stations operating on the wavelength channels available, which number under 100, a great many broadcasters must necessarily find it impossible to operate on a wavelength to which no other station has a prior right, and on which they will cause no interference. If other courts affirm Judge Wilson's decision, the congestion on the air may soon be cleared up without Congressional action.

* *

New York City's "Radio University"

THAT New York's free public lectures, often called the "university of the people," are to be put on the air, was recently announced by William O'Shea, City Superintendent of Schools. This change, it is believed, will bring the lectures to more people than ever before, while at the same time making it possible to use fewer speakers and lecture centers. The lectures will be broadcast through station WNYC on Monday evenings.

* *

Short-Wave Trans-Atlantic Telephones

FOLLOWING fast on the opening of the new trans-Atlantic telephone service comes an announcement from England that secret tests with a short-wave beam system, promise a trans-oceanic telephone service that will be cheaper, more reliable and more private than the one now in use. The tests, which are being conducted by Marconi engineers, have been made between London and Montreal on 30 to 60 meter beams; much less power is necessary than with the 5000-meter wavelength now in use.

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"Radio Weather" Forecasts

MR. R. G. LYNCH of the *Milwaukee Journal* forecasts each day the "radio weather" for the evening, and indicates from what points the fans may expect good reception. Although he has so far been able to make general forecasts with some degree of success, his task is complicated by the fact that no one knows for certain all of the factors that govern radio reception as well as by the rapidity with which pressure areas (which are believed to affect reception) move.

* *

A Hospital Where Patients Pick Their Programs

PROBABLY the best radio-equipped hospital in the world, is the new Allison Hospital at Miami Beach, Florida, where each patient has a complete radio set to himself, with a separate antenna, so that he may tune any station or program he desires. As only single-control receivers are used each patient has no trouble in tuning in. Ordinarily, in hospital installations, a master set is used and the patient has no choice of programs.

* *

Amateurs Hold an 8,000-Mile Daylight Conversation

WHAT is said to be a record for daylight amateur communication on short waves was established recently when Lyndon Farwell (U-6ZAT) of Los Gatos, California talked for half an hour with M. Samuel (G-5HS) of London, England. Both transmitters were home-made and operated with a 200-watt input on a wavelength of 20 meters.

* *

Canada Bans Direct Radio Advertising

DIRECT radio advertising, generally and wisely shunned by American broadcasters, was given a death blow in Canada recently when it was prohibited by law, except, in the special cases of charitable announcements. This ban does not affect the broadcasting of programs paid for or furnished by commercial firms, but it does aim to prevent the misuse of radio by the broadcasting of straight advertising talks which listeners believe is out of place on the air.

* *

Socialists Plan a Station as a Memorial

A POWERFUL broadcasting station in one of the largest cities of the country is the unique monument that the Socialist Party hopes to erect in honor of its dead leader, Eugene V. Debs. With the idea that such a station will be "in keeping with Debs's record as a fearless defender of free speech" the party hopes to raise $200,000 by public subscription to build or buy the memorial station and to put on the air the doctrines that made Debs famous.

SM

Look - You'll Find Them

Possessing a 3:1 turn ratio, the 220 audio transformer has the highest primary impedance of any known transformer. The impedance values—the criterion of uniform amplification—are 19,000 ohms at 30 cycles and 626,000 ohms at 1000 cycles, approximately.

THAT'S the S-M sales story—just that S-M parts must be right, or you wouldn't find them in over half of the important circuits. Turn where you will, the proof of good engineering judgment lies at hand in the selection by authorities of S-M parts for the circuits you'll build.

Do you realize that in the new field of A.C. operated receivers that over half of all designs ever offered use S-M power units as a basis—that they have led all others by a wide margin?

Do you know that S-M Audio Transformers are found in more of this season's receiver designs than any others—that independent testing laboratories everywhere prove them to be superior—that less than one in every four thousand of these transformers comes back to the factory for refund? Yet each is guaranteed to give more satisfying qualities than any other amplifying devices that the market offers!

There can only be one answer—that S-M products are right. Prominent engineers say so and have backed their opinion by using them—every important magazine authority says so. And sales talk—just ask any live dealer what his fastest selling parts are, and he'll answer "S-M."

That's only half the story—the list below is why you, too, will eventually use S-M parts.

S-M audio transformers, output transformers, coils or power units have been selected for the following circuits—and in many form the basis of design. In this list are included the most popular recent designs.

Infradyne
Shielded Six
Silver-Cockaday
Best's A.C. Browning Drake
Best's A.C. Diamond of the Air
Radio News Batteryless Receiver
Radio Broadcast Super
Radio Age Super
Radio Broadcast Local
LC-27 Junior Power Pack
Citizens Call Book Monotune Receiver
Call Book Power Pack
Callies Super
Radio Mechanics "A," "B" and "C" Eliminator
Radio Engineering "A," "B" and "C" Eliminator
Radio Mechanics Man-o-War Super
Lincoln Super
Best's Short Wave Set
Hush-Hush II Short Wave Set
Popular Mechanics Super
Christian Science Monitor 6 tube Browning-Drake
Radio Engineering Short Wave Set
New York Sun "B" and "C" Eliminator for Resistance Amplifier
Chicago American Short Wave Set
Chicago Post Power Amplifier
Best's new Super
Radio News Power Amplifier
Loftin-White
Popular Radio Town and Country
Radio News Super
Nahken's Ultra-Five
Taylor's Pre-Selector
Chicago News Short Wave Adopter

Silver-Marshall, Inc.

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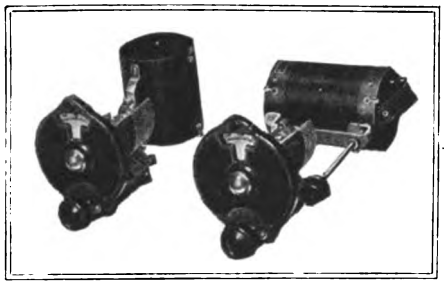
BROWNING-DRAKE RADIO



BUILD the NEW Browning-Drake OFFICIAL KIT SET

Designed by

Glenn H. Browning

BROWNING-DRAKE Radio is known to almost every radio fan. Countless radio designs have come and gone since 1923 but Browning-Drake continues to grow in popularity and evokes the same genuine enthusiasm that it did over three years ago. Any development based on such sound scientific research as the Browning-Drake work at Harvard University, was bound to endure.

For the fan who desires to build his own, Browning-Drake is now offered in a new OFFICIAL design APPROVED by Glenn H. Browning and Dr. Frederick H. Drake. The constructing is made easy by instructions contained essentially in every kit, or sent in booklet form upon receipt of twenty-five cents.

If your dealer cannot supply you with the Browning-Drake Corporation Kit, send us his name and address and we will take care of your requirements immediately.

DEALERS: The new Browning-Drake kit, designed complete in conjunction with several well-known manufacturers, is now available from your distributor. If you are unable to secure kits and specified parts from distributors in your territory, we will see that your order is filled.

BROWNING-DRAKE CORP.
BRIGHTON MASS.

Radio Gives War Tanks a Voice and An Ear

THE crew of a tank, up till now nearly as isolated as the occupants of a penitentiary cell, will now be able to keep in communication with other tanks or with their base, up to fifty miles distance by means of a new wireless apparatus that has just been invented by an English officer. When this apparatus is used it is possible to transmit and receive clear speech even when the tank is bumping its way along over broken ground and fallen trees.

* *

Bored Radio Fan Stops Legislature's Speech

ONE of the dangers of broadcasting the discussions of legislative bodies were illustrated to legislators recently in Finland, when a listener in 100 miles away, bored by a long discourse on ham and bacon, broadcast from the Finnish Diet, telephoned in to tell the long-winded orator that he would certainly be defeated in the next elections if he did not stop at once. The speaker took the hint.

* *

A Curfew Hour Set for Radio

MIDNIGHT was recently judged to be a reasonable hour for a curfew on noisy radio reception by Magistrate Brodsky of a New York City Court. Complaints had been made that an ardent radio fan kept his neighbors awake until all hours of the night by his apparently successful attempts at loudspeaker DX reception. The magistrate decided that people are entitled to their rest after midnight and the ardent fan promised to shut off his set by that time or use earphones for the rest of the evening.

* *

Europe Plans Utopian Broadcasts

EUROPEAN listeners in may soon be presented with the finest broadcast programs that have ever been put on the air if present plans for an international exchange of programs are carried out. A new society (the *Commission de Raprochement Intellectuel Artistique et Social*) has been formed at Geneva, Switzerland to promote an exchange of programs between the European nations; the project includes a proposal to set aside a certain evening for each nation to broadcast a program that shall contain the best from both a literary and musical standpoint that the nation itself has been able to produce.

* *

The photograph of the North Pole taken by American airmen discloses only a hole in the ice. It is presumed that some unscrupulous Eskimo stole the thing for his antenna.

—LONDON OPINION

FREE PARTS for the "LC-27 Broadcast Receiver"

If you want to build your own set, here is your opportunity to secure FREE all the parts you need for the LC-27 Broadcast Receiver. Call on all your radio friends, and on anyone who has a set and tell them of the many special features of POPULAR RADIO.

These liberal offers will make it possible for you to secure an order from every one you call upon. For each subscription with remittance you send us you will receive credits as per the following scale:

POPULAR RADIO

4 Months	for	$1.00	counts	16	credits
6 "	"	1.50	"	25	"
8 "	"	2.00	"	33	"
12 "	"	3.00	"	50	"
24 "	"	5.00	"	75	"

Send us the full amount collected with names and addresses of subscribers and tell us the parts your credits entitle you to and we will send them to you. If the subscriptions you secure do not give you enough credits for the parts you want, we will allow you to purchase credits at the rate of 3 cents each. Example: With (7) seven 1-year subscriptions (350 credits) and $1.50 additional in cash you may have an Amertran De Luxe first-stage radio-frequency transformer, for which you need 400 credits.

If the parts you want are not listed in the advertisement, we are prepared to supply them. Let us know what you want and we will tell you how many credits you will need.

On page 313 are described POPULAR RADIO'S Simplified Blueprints. You can have any set of prints you want for only 40 credits. You may also secure a copy of "How to Build Your Radio Receiver" described on page 310 for 60 credits.

CREDITS Needed for Parts Required for the LC-27 BROADCAST RECEIVER

(Described and illustrated in the October 1926 Issue of POPULAR RADIO.)

Quantity	Item	Credits
1	Hammarlund mid-line dual condenser, .000275 mfd	300
1	Hammarlund mid-line single condenser, .000275 mfd	186
1	Precision Duo-Octaform coil set, one antenna coupler and two interstage couplers	420
1	Amertran De Luxe first-stage transformer	400
1	AmerTran De Luxe second-stage transformer	400
1	Amerchoke No. 854	240
1	Dubilier No. 902 filter condenser, .4 mfd	20
1	Dubilier No. 907 Filter Condenser, .4 mfd	24
1	Mar-Co illuminated control, scale 0 to 100	140
2	Mar-Co small controls for LC-27	60
1	Carter battery switch	26
1	Samson radio-frequency choke coil No. 85	60
3	Averovex mica fixed condensers, .00025 mfd	42
1	Durham resistor, 4 megohms	20
1	Lynch grid leak mounting	14
1	Carter Gem Jack	10
1	Carter resistance, 0-10,000 ohms	80
10	Eby binding posts	60
5	Benjamin UX sockets	150
1	Amperite	44
	Mechanical Kit consisting of aluminum shields, binding post strip, decorated panel and Tait brackets	500
	Total	3408

Write for List of Free Parts for Other Popular Radio Receivers

POPULAR RADIO
Department 31A
627 West 43d St., New York City

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Changes in the List of Broadcasting Stations in the U. S.

During the month of January, 1927 the following changes were reported in the list of broadcasting stations:

STATIONS ADDED

KGDW	Humboldt, Nebraska	241.8
KGEF	Los Angeles, California	516.9
KGEH	Eugene, Oregon	236.1
KGEK	Yuma, Colorado	252.0
KGEL	Jamestown, North Dakota	225.0
KGEN	El Centro, California	281.0
KGEQ	Minneapolis, Minnesota	330.0
KGER	Long Beach, California	325.9
KGES	Central City, Nebraska	205.4
KGEU	Lower Lake, California	222.0
KGEW	Fort Morgan, Colorado	256.0
KGEY	Denver, Colorado	204.0
KGRC	San Antonia, Texas	315.0
KKP	Seattle, Washington	260.0
KMED	Medford, Oregon	250.0
KMIC	Inglewood, California	387.0
KOMO	Seattle, Washington	305.9
KPCB	Seattle, Washington	521.0
KROW	Portland, Oregon	231.0
WABQ	Philadelphia, Pennsylvania	260.7
WAOK	Ozone Park, New York	247.8
WBMH	Detroit, Michigan	352.7
WCOT	Olneyville, Rhode Island	265.3
WGL	New York, New York	442.4
WJAY	Cleveland, Ohio	435.7
WJPW	Ashtabula, Ohio	239.9
WLBT	Crown Point, Indiana	230.0
WLBU	Canastota, New York	220.0
WLBV	Mansfield, Ohio	230.6
WLBW	Oil City, Pennsylvania	321.0
WLBX	Long Island City, New York	230.6
WLBY	Iron Mountain, Michigan	249.9
WLBZ	Dover-Foxcroft, Maine	299.0
WMBA	Newport, Rhode Island	249.9
WMBD	Peoria Heights, Illinois	279.0
WMBE	St. Paul, Minnesota	220.0
WMBG	Richmond, Virginia	220.0
WMBH	Chicago, Illinois	280.0
WMBJ	Monessen, Pennsylvania	277.6
WMBK	Hamilton, Ohio	360.0
WMBL	Lakeland, Florida	410.0
WSEA	Virginia Beach, Virginia	516.9
WSIX	Springfield, Tennessee	250.0

STATIONS DELETED

KFGQ	Boone, Iowa
KFRW	Olympia, Washington
WKBR	Auburn, New York
WTAB	Fall River, Massachusetts

CHANGES IN CALL LETTERS

WAHG	Richmond Hill, N. Y.	*change to*	WABC
KGEA	Seattle, Washington	*change to*	KUJ
WJBV	Woodhaven, N. Y.	*change to*	WSOM

CHANGES IN WAVELENGTHS

WEHS	Evanston, Ill., 202.6	*change to*	241.8
WCBS	Providence, R. I., 242	*change to*	242.
KFKB	Milford, Kan., 431.4	*change to*	434.5
WKBO	Jersey City, N. J., 303.9	*change to*	220.4
WAFD	Detroit, Mich., 275.1	*change to*	312.3
KRLD	Dallas, Tex., 353	*change to*	357.1
WSBT	South Bend, Ind., 315	*change to*	315.6
KUJ	Seattle, Wash., 345	*change to*	352.5
KVI	Tacoma, Wash., 242.5	*change to*	312.5
KJBS	San Francisco, Cal., 234.2	*change to*	220.4
WBRL	Tilton, N. H., 365	*change to*	420.0
WWAE	Chicago, Ill., 384.4	*change to*	241.8
KLZ	Denver, Col., 265.3	*change to*	284.4
WSOM	Woodhaven, N. Y., 469.9	*change to*	288.3

CHANGES IN LOCATIONS

WEHS	Chicago, Ill.,	*change to*	Evanston, Ill.
WAFD	Port Huron, Mich.,	*change to*	Detroit, Mich.
WBMS	North Bergen, N. J.,	*change to*	Union City, N. J.
WWAE	Plainfield, Ill.,	*change to*	Chicago, Ill.
KFEQ	Oak, Neb.,	*change to*	St. Joseph, Mo.
WREC	Coldwater, Miss.,	*change to*	Whitehaven, Tenn.

* *

Trans-Oceanic Calls Heard

THE following stations were received nd logged at the amateur station of ouis Groizelier (F-8JC) at 12, Route 'Etain, Verdun-S-Meuse, France on a egenerative detector and one stage of udio.

U-1AVL—Dec. 12, 1926; signal strength 8; 50-cycle AC note on 39 meters; noticeble interference and atmospherics.

U-5JF—Dec. 10, 1926; signal strength 6; 50-cycle AC note; bad fading and tmospherics.

U-2AKJ—Dec. 12, 1926; signal strength 8; 50-cycle AC note on 39 meters; noticeble interference and atmospherics.

Apparently Alike-

Tubes of the same make and type. Both "light". Both "work". Yet one is very sensitive. The other is not . . . . . why?

Tubes 'run down', too

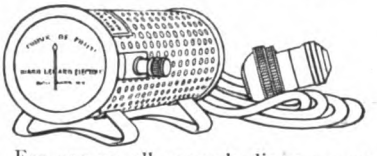
BECAUSE your tubes work is no sign that they do your set justice. *Tubes quickly lose sensitivity.* The set loses power and volume, requires more current. You are puzzled—

A well-posted dealer will advise you to buy a Jefferson Tube Charger. Once a month, connect it for ten minutes to the "A" terminals of your set. Thereafter with tubes always like new, enjoy top-notch reception *every* night. Longer life of tubes and batteries more than repays you. Patented, guaranteed and made only by Jefferson. $5. Get one this week!

JEFFERSON ELECTRIC MFG. CO.
Largest manufacturers of small transformers
508 So. Green Street, Chicago
[PATENTED]

Jefferson
№275 Tube Charger

Vitrohm Trickle Charger

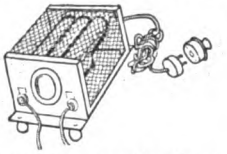


For use on all 110-volt direct current lines. Used as a continuous duty A-battery charger. Charging rate is 0.3 amperes.

Charges storage B-batteries in units up to 90 volts.

Vitrohm Trickle Charger is equipped with separable plug, 6 foot extension cord and polarity indicator.

Vitrohm Standard Charger



For use on all 110-volt direct current lines. Used as a standard A-battery charger. Charging rate is approximately 3 amperes.

Compact, unlimited life, and easily installed. Vitrohm Battery Charger is equipped with separable plug and 6 foot extension cord.

A polarity indicating Ammeter shows charging rate.

Bulletin 507 lists all Vitrohm Resistors for radio. It will be sent free upon request.

Ward Leonard Electric Company
Mount Vernon, New York
Mount Vernon New York

A Novel and Efficient Detector Receiver
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Home .·. Office .·. Hotel

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Complete Radio Receiver

Pair of standard Ear Phones, Aerial and Ground Leads, Indoor Antenna, Self-contained in attractive book.

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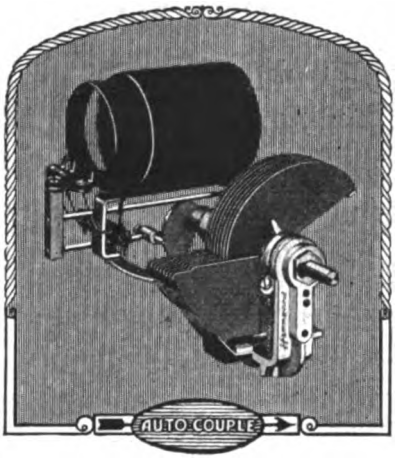
Messrs. Haynes *and* Cockaday Score Another Success



And Two Hammarlund Auto-Couple Units Share the Applause

THE "Uni-Valve" Circuit designed by A. J. Haynes and Laurence Cockaday makes one tube do the work of three. That's a big job for the designers—but a bigger one for the tube. It needs all the help it can get.

The two Hammarlund Auto-Couple Units used in the "Uni-Valve" Receiver, deliver maximum input signal strength at each condenser setting and aid materially in gaining selectivity and control over undesirable oscillations.

Primary coil couplings are automatically varied by cams attached to the full-floating rotor shafts of the "Midline" Condensers.

"Auto-Couple" units can be used with equal efficiency in any other circuit, where variable primary coupling is desired. The "Midline" condenser has a removable rotor shaft, making it adaptable to any scheme of single-control, multiple condenser operation.

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Hammarlund
PRECISION
PRODUCTS

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☐ Set No. 22 ☐ Set No. 27
☐ Set No. 23

(See page 313 for description of Sets)

Name.....

Address.....

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Foreign postage 50c extra No extra for Canada.

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Improved Browning-Drake
with
Popular Radio
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Blue Prints

Easy, Quick and Accurate

The Improved Browning-Drake Broadcast Receiver, designed by Arthur H. Lynch, former Editor of Radio Broadcast and built and approved in the POPULAR RADIO LABORATORY.

Here is a receiver which combines all the advantages of a circuit that has long been recognized as standard with new ideas and improvements which have been made in receiver construction since the circuit was first designed.

High efficiency that emphasizes fine tone quality is the outstanding characteristic of this new model.

By using POPULAR RADIO Blue Prints in building your Improved Browning-Drake Broadcast Receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory model (see page 313).

If your local dealer cannot supply you with Blue Prints of the Improved Browning-Drake, they will be sent postpaid upon receipt of $1.00 per set.

A full description of this set, with detailed directions for building, was published in the August, 1926, issue of POPULAR RADIO. Send 35c for copy.

POPULAR RADIO

Service Bureau 34-C

627 W. 43rd St., New York City

Outstanding Program Features of the Month

FEBRUARY 20th TO MARCH 15th

DURING the coming month, February 20th to March 15th, the following regular and special program features are scheduled. This list, which will be augmented monthly as advance information is received, will be published in each issue of the magazine; all broadcast stations are invited to report coming program features of outstanding interest of importance. Reports should reach the Editor of POPULAR RADIO on or before the 23rd of the month preceding.

FEBRUARY

(Eastern Standard Time)

20th; *Capitol Theatre Grand Orchestra*, WEAF; 7:20 P.M. (Also broadcast from KSD, WRC, WWJ, WSAI, WCAE and WTAG).
Atwater Kent Hour, WEAF; 9:15 P.M. (Also broadcast from WSAI, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ and KSD).
Godfrey Ludlow, WJZ; 9:30 P.M. (Also from WGY).
Maxwell House Coffee Hour, WJZ; 10:15 P.M. (Also from WBZ, WRC, WGY and KDKA).

21st; *Willys-Overland Hour*, WJZ; 8:30 P.M.
A & P Gypsies, WEAF; 9:00 P.M. (Also from WEEI, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ)
Fireside Boys, WJZ; 9:15 P.M.
B. A. Rolfe's Palais D'Or Orchestra, WEAF; 11:00 P.M.

22nd; *Classical music*, WRNY; 8:00 P.M.
Vikings, WEAF; 8:00 P.M. (Also broadcast from WEEI, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC).
Jolly Buckeye Bakers, WEAF; 8:30 P.M. (Also from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG and WLIB).
Eveready Hour, WEAF; 9:00 P.M. (Also from WEEI, WFI, WCAE, WCCO, WTAM, WGN, WSAI and WTAG).
Champion Spark Pluggers, WJZ; 8:00 P.M. (Also broadcast from WGY and WRC).
Keystoners, WJZ; 9:00 P.M. (Also from WRC and WGY).
Auction Bridge Instructions, WEAF; 10:00 P.M. (Also from WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO and KSD).
Amaco Hour, WJZ; 10:00 P.M. (Also from KDKA and KYW).
George Olsen's Orchestra, WJZ; 10:45 P.M.

23rd; *Eastman Theatre Orchestra*, WJZ; 6:30 P.M. (Also from WHAM).
Davis Saxophone Octette, WEAF; 8:30 P.M. (Also from WEEI, WJAR, WLIT, WRC, WTAG and WCAE).
Iodent Half Hour, WJZ; 8:30 P.M. (Also from WBZ, KDKA and KYW).
Sixty White Minutes, WJZ; 9:00 P.M. (Also from WBZ, KDKA and KYW).
Ipana Troubadours, WEAF; 9:00 P.M. (Also from WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).
Smith Brothers, WEAF; 10:00 P.M. (Also from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF).
Armchair Hour, WJZ; 10:00 P.M.

24th; *Clicquot Club Eskimos*, WEAF; 9:00 P.M. (Also from WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ).
Goodrich Zippers, WEAF; 10:00 P.M. (Also from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSI, WWJ, WSAI and WADC).
RCA Radiotrons, WJZ; 9:00 P.M. (Also from WBZ, KDKA and KYW).

25th; *Happiness Boys*, WEAF; 8:00 P.M.
Royal Typewriter Orchestra, WGY; 9:00 P.M. (Also from WRC, WBZ and WJZ).
Breyer Hour, WJZ and WRC; 9:00 P.M.
LaFrance Orchestra, WEAF; 9:00 P.M. (Also from WEEI, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).

26th; *New York Symphony Orchestra with Walter Damrosch*, WEAF; 9.15 P.M. (Also from WEEI, WGR, WFI, WCAE, WWJ, WSAI, WTAM, WGN, KSD, WCCO and WDAF).

27th; *Capitol Theatre Grand Orchestra*, WEAF; 7:20 P.M. (Also from KSD, WRC, WWJ, WSAI, WCAE and WTAG).
Atwater Kent Hour, WEAF; 9:15 P.M. (Also from WSAI, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ and KSD).
Godfrey Ludlow, WJZ; 9:30 P.M. (Also from WGY).
Maxwell House Coffee Hour, WJZ; 10:15 P.M. (Also from WBZ, WRC, WGY and KDKA).

28th; *Willys-Overland Hour*, WJZ; 8:30 P.M.
A & P Gypsies, WEAF; 9:00 P.M. (Also from WEEI, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ).
Fireside Boys, WJZ; 9:50 P.M.
B. A. Rolfe's Palais D'Or Orchestra, WEAF; 11:00 P.M.

MARCH

1st; *Classical music*, WRNY; 8:00 P.M.
Vikings, WEAF; 8:00 P.M. (Also from WEEI, WJAR, WTAG, WGR, WFI,

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WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC).
Jolly Buckeye Bakers, WEAF; 8:30 P.M. (Also from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG, WLIB).
Eveready Hour, WEAF; 9:00 P.M. (Also from WEEI, WFI, WCAE, WCCO, WTAM, WGN, WSAI and WTAG).
Champion Spark Pluggers, WJZ; 8:00 P.M. (Also broadcast from WGY, WRC).
Keystoners, WJZ; 9:00 P.M. (Also from WRC and WGY).
Auction Bridge Instructions, WEAF; 10:00 P.M. (Also from WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO and KSD).
Amazo Hour, WJZ; 10:00 P.M. (Also from KDKA and KYW).
George Olsen's Orchestra, WJZ; 10:45 P.M.
2nd; *Eastman Theatre Orchestra*, WJZ; 6:30 P.M. (Also from WHAM).
Davis Saxophone Octette, WEAF, 8:30 P.M. (Also from WEEI, WJAR, WLIT, WRC, WTAG and WCAE).
Iodent Half Hour, WJZ; 8:30 P.M. (Also from WBZ, KDKA and KYW).
Sixty White Minutes, WJZ; 9:00 P.M. (Also from WBZ, KDKA and KYW).
Ipana Troubadours, WEAF; 9:00 P.M. (Also from WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).
Smith Brothers, WEAF; 10:00 P.M. (Also from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF).
Armchair Hour, WJZ; 10:00 P.M.
3rd; *Clicquot Club Eskimos*, WEAF; 9:00 P.M. (Also from WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ).
Goodrich Zippers, WEAF; 10:00 P.M. (Also from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSAI, WWJ, WSI and WADC).
RCA Radiotrons, WJZ; 9:00 P.M. (Also from WBZ, KDKA and KYW).
4th; *Happiness Boys*, WEAF; 8:00 P.M.
Royal Typewriter Orchestra, WGY; 9:00 P.M. (Also from WRC, WBZ and WJZ).
Breyer Hour, WJZ and WRC; 9:00 P.M.
La France Orchestra, WEAF; 9:00 P.M. (Also from WEEI, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).
5th; *New York Symphony Orchestra with Walter Damrosch*, WEAF; 9:15 P.M. (Also from WEEI, WGR, WFI, WCAE, WWJ, WTAM, WGN, KSD, WCCO and WDAF).
6th; *Capitol Theatre Grand Orchestra*, WEAF; 72:0 P.M. (Also from KSD, WRC, WWJ, WSAI, WCAE and WTAG).
Atwater Kent Hour, WEAF; 9:15 P.M. (Also from WSAI, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ and KSD).
Godfrey Ludlow, WJZ; 9:30 P.M. (Also from WGY).
Maxwell House Coffee Hour, WJZ; 10:15 P.M. (Also from WBZ, WRC, WGY and KDKA).
7th; *Willys-Overland Hour*, WJZ; 8:30 P.M.
A & P Gypsies, WEAF; 9:00 P.M. (Also from WEEI, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ).
Fireside Boys, WJZ; 9:50 P.M.
B. A. Rolfe's Palais D'Or Orchestra, WEAF; 11:00 P.M.
8th; *Classical music*, WRNY; 8:00 P.M.
Vikings, WEAF; 8:00 P.M. (Also from WEEI, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC).
Jolly Buckeye Bakers, WEAF; 8:30 P.M. (Also from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG and WLIB).
Eveready Hour, WEAF; 9:00 P.M. (Also from WEEI, WFI, WCAE, WCCO, WTAM, WGN, WSAI and WTAG).
Champion Spark Pluggers, WJZ; 8:00 P.M. (Also from WGY and WRC).
Keystoners, WJZ; 9:00 P.M. (Also from WRC and WGY).
Auction Bridge Instructions, WEAF; 10:00 P.M. (Also from WEEI, WCSH, WTAH, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO and KSD).
Amazo Hour, WJZ; 10:45 P.M.
9th; *Eastman Theatre Orchestra*, WJZ; 6:30 P.M. (Also from WHAM).
Davis Saxophone Octette, WEAF; 8:30 P.M. (Also from WEEI, WJAR, WLIT, WRC, WTAG and WCAE).
Iodent Half Hour, WJZ; 8:30 P.M. (Also from WBZ, KDKA and KYW).
Sixty White Minutes, WJZ; 9:00 P.M. (Also from WBZ, KDKA and KYW).
Ipana Troubadours, WEAF; 9:00 P.M. (Also from WGR, WRC, WCAE, WWJ, WLIB, KSD and WCCO).
Smith Brothers, WEAF; 10:00 P.M. (Also from WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO and WDAF).
Armchair Hour, WJZ; 10:00 P.M.
10th; *Clicquot Club Eskimos*, WEAF; 9:00 P.M. (Also from WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI and WWJ).
Goodrich Zippers, WEAF; 10:00 P.M. (Also from WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WSAI, WWJ, WSI and WADC).
RCA Radiotrons, WJZ; 9:00 P.M. (Also from WBZ, KDKA and KYW).

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1 Hammarlund mid-line dual condenser, .000275 mfd.	$ 7.50
1 Hammarlund mid-line single condenser, .000275 mfd.	4.65
1 Precision Duo-Octoform coil set comprising one antenna coupler and two interstage couplers	10.50
1 Amertran De Luxe first stage transformer	10.00
1 Amertran De Luxe second-stage transformer	10.00
1 Amerchoke # 854	6.00
1 Dubilier or Tobe 4 mfd. Filter condenser	5.50
1 Dubilier filter condenser, .1 mfd.	.60
1 Mar-Co illuminated control, scale 0 to 100	3.50
2 Mar-Co small controls scale 0 to 50 and 50 to 0	1.50
1 Carter Battery Switch	.65
1 Samson radio-frequency choke coil # 85	$1.50
3 Aerovox, mica fixed condensers, .00025 mfd.	1.05
1 Durham or Daven Resistor 4 meg.	.50
1 Lynch Grid Leak Mounting	.35
1 Carter Gem Jack	.25
1 Carter variable resistance, 0-10,000 ohms.	2.00
12 Eby binding posts	1.80
6 Benjamin UX Sockets	3.75
1 Amperite No. 1	1.10
Mechanical Kit consisting of aluminum shields, binding post strip, decorated panel and Tait brackets	12.50

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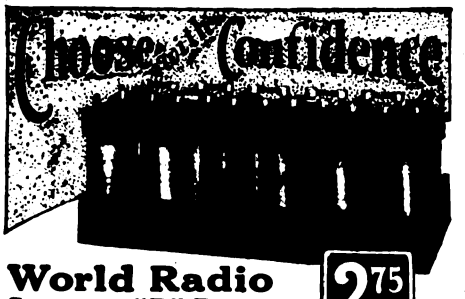

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Prices: 6-volt, 100 Amp. $10.00; 180 Amp. $12.00; 110 Amp. $12.00. All equipped with Solid Rubber Case.

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11th; *Bryer Hour*, WJZ and WRC; 9:00 P.M.
La France Orchestra, WEAF; 9:00 P.M. (Also from WEEI, WGR, WLIT, WOC, WCAE, WTAM, WDAF, WWJ and KSD).
12th; *New York Symphony Orchestra with Walter Damrosch*, WEAF; 9:15 P.M. (Also WEEI, WGR, WFI, WCAE, WWJ, WTAM, WGN, KSD, WCCO and WDAF).
13th; *Capitol Theatre Grand Orchestra*, WEAF; 7:20 P.M. (Also from KSD, WRC, WWJ, WSAI, WCAE and WTAG).
Atwater Kent Hour, WEAF; 9:15 P.M. (Also from WSAI, WEEI, WFI, WCCO, WTAM, WGN. WCAE, WGR, WOC, WTAG, WWJ and KSD).
Godfrey Ludlow, WJZ; 9:30 P.M. (Also from WGY).
Maxwell House Coffee Hour, WJZ; 10:15 P.M. (Also from WBZ, WRC, WGY and KDKA).
14th; *Willys-Overland Hour*, WJZ; 8:30 P.M.
A & P Gypsies, WEAF; 9:00 P.M. (Also from WEEI, WJAR, WDAF, WRC, WCSH, WCAE, WTAM, WLIT and WWJ).
Fireside Boys, WJZ; 9:50 P.M.
B. A. Rolfe's Palais D'Or Orchestra, WEAF; 11:00 P.M.
15th; *Classical music*, WRNY; 8:00 P.M.
Vikings, WEAF; 8:00 P.M. (Also from WEEI, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO and WOC).
Jolly Buckeye Bakers, WEAF; 8:30 P.M. (Also from WFI, KSD, WSAI, WCCO, WTAM, WWJ, WTAG and WLIB).
Eveready Hour, WEAF; 9:00 P.M. (Also from WEEI, WCAE, WCCO, WTAM, WGN, WSAI and WTAG).
Champion Spark Pluggers, WJZ; 8:00 P.M. (Also from WGY and WRC).
Keystoners, WJZ; 9:00 P.M. (Also from WRC and WGY).
Auction Bridge Instructions, WEAF; 10:00 P.M. (Also from WEEI, WCSH, WTAH, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO and KSD).
Amazo Hour, WJZ; 10:45 P.M.
16th; *Eastman Theatre Orchestra*, WJZ; 6:30 P.M. (Also from WHAM).
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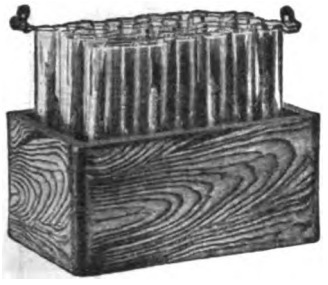

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WCCO, at Minneapolis—St. Paul, also boasts a "find" in Howard Melaney who has just quit shoveling coal on a Northern Pacific locomotive running between Glendive and Forsythe, Montana. He is a tenor of such promise that the WCCO announcers speak of him as "The Mountain McCormack." He has always enjoyed singing, but up to a short time ago he had no training other than what he could give himself and what he could get in the church choirs that he joined from time to time. It took about all he could earn on his railroad job to support his mother, his younger brother, a sister and himself. Through many a small economy he scraped together enough money to buy a phonograph and records of his favorite tenors. During the evenings he could spend at home, he played these records over and over again, so that he might study the voices and their technique and so improve his own voice.

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But the fireman had to keep on his job for a while. He stoked the furnace on his favorite engine, singing at intervals from WCCO. But his name spread fast, and before long he found his time mostly taken up with calls for concerts and theatrical performances. And it was his income from these that finally made it possible for him to resign his position on the railroad and study music in good earnest.

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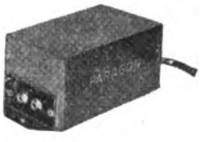

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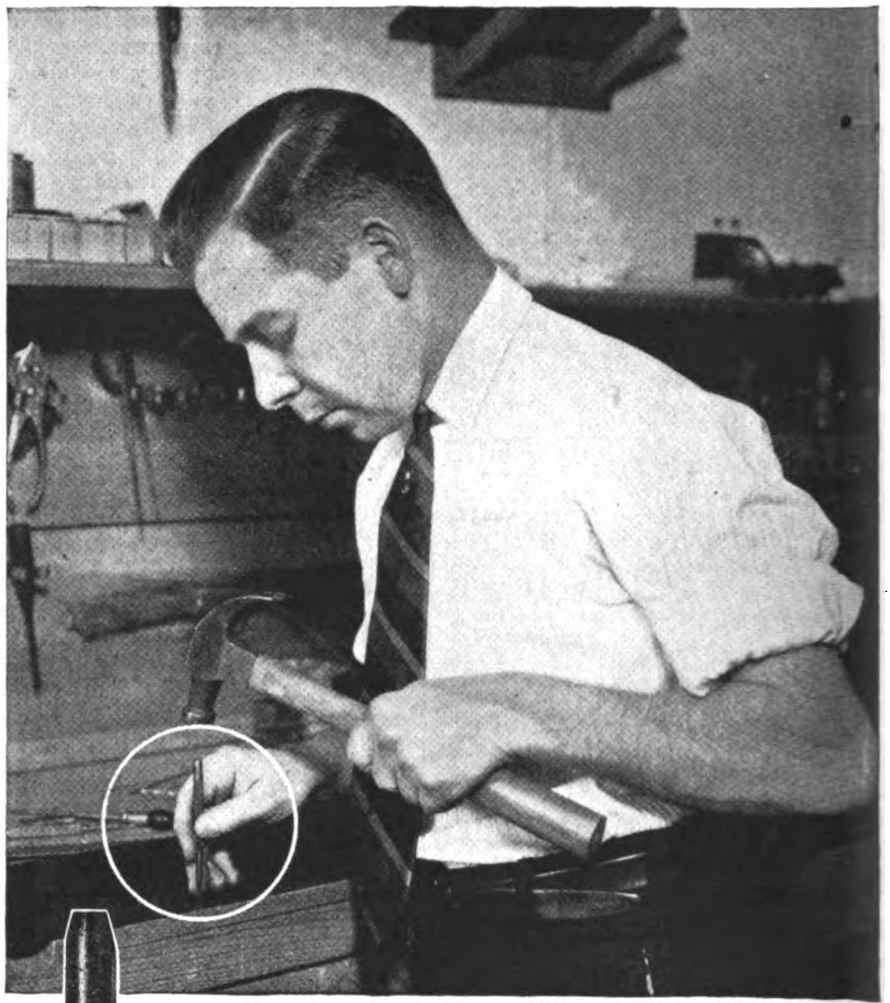

From a photograph made for POPULAR RADIO

THE CENTER PUNCH

A tool for punching "starting" holes for drilling panels

THIS instrument is made somewhat on the general style of the scriber. It is, however, made of heavier stock than the scriber and instead of hand pressure being used to make a mark, it may be struck a sharp blow with a hammer to make a larger dent in the material being marked. After the positions for the holes have been pin-pricked with the scriber, the center punch is used to deepen them so that the point of the drill will fit and a true start will be made in drilling. This handy tool is usually fashioned as shown in the photograph, with a knurled surface running down to a rugged point at one end, and with the other end finished off flat and hardened so that it will withstand the blows from the hammer.

The preceding suggestions in this series were SIDE-CUTTING PLIERS, SCREW-DRIVERS, THE HYDROMETER, THE BATTERY-TESTING VOLTMETER, THE FILE, THE JACK KNIFE, THE ELECTRIC SOLDERING IRON, THE SOCKET WRENCH, THE HAND DRILL *and* THE SCRIBER.

Popular Radio

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APRIL 1927

— For the Fan —
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— For the Experimenter —
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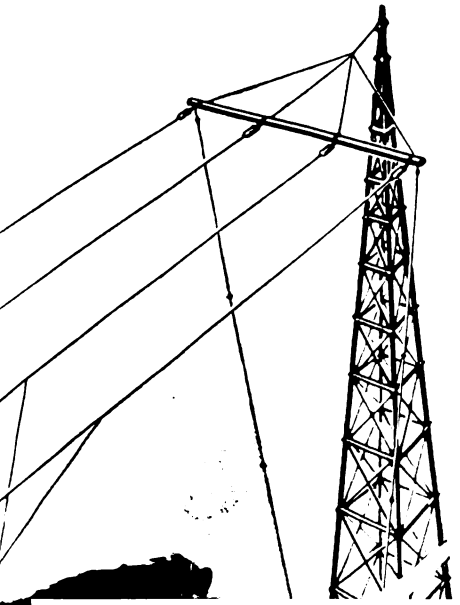

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and RADIOTRONS UX-199 for all-round quality.

RCA Radiotron

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Popular Radio

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VOLUME XI | April, 1927 | NUMBER 4

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Broadcast Listener.....*Raymond Francis Yates*.410

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JOHN V. L. HOGAN, *Contributing Editor*

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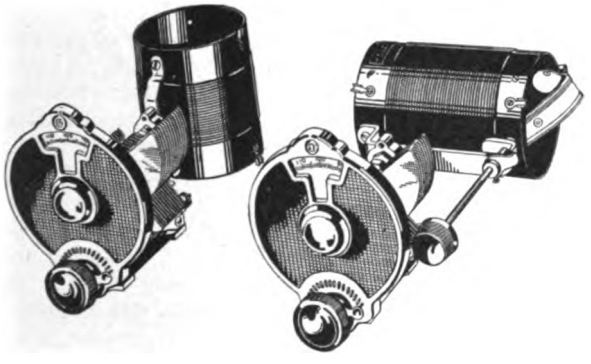
BUILD

The New BROWNING-DRAKE



Official Kit Set

THE new Browning-Drake Assembly is now presented to the fans of this country, and with it the Browning-Drake Corporation announces the new Kit, designed for use in this new receiver. With its greatly increased selectivity and pleasing appearance, this Browning-Drake will hereafter be designated "Official."

Complete Browning-Drake factory-built receivers are now standard on the market. The well-known model 5-R has earned an unusual reputation for consistent performance and negligible dealer service. Your dealer will be glad to demonstrate this receiver.

DEALERS: There should be at least one distributor in your territory handling complete receivers, as well as all the parts for the Official Kit Assembly. We will be glad to forward the name of our nearest jobber.

BROWNING-DRAKE CORPORATION
BRIGHTON :: MASS.

BROWNING-DRAKE RADIO

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A Page With The Editor

On page 370 of this issue starts the first of the expanded list of star broadcast program features of the month—features of outstanding merit during the coming month, beginning March 20th.

* *

The purpose of this list is self-evident; to give our readers authoritative information about the programs just ahead—and to give that information specifically and by names that may be identified.

* *

The present policy of the newspapers in omitting the identifying names of these standard features in their daily program lists (apparently inspired by the purpose of the business office to force paid advertising) has made the newspaper programs practically valueless to the radio fan.

* *

When a newspaper, in its effort to avoid "free advertising," goes to the extreme of listing the New York Symphony orchestra (that appears on the Balkite Hour) merely as a "salon orchestra," it appears to be about time for some publication to serve the interests of the fans by giving them the advance information they want.

* *

So Popular Radio is stepping right up to meet this need.

* *

This present installment is merely the foundation of what will be gradually expanded into a regular and valuable feature of the magazine; advance information is not always easy to get.

* *

All of the program features included on this star list are worth tuning in on; they are really features of outstanding merit in their respective lines.

* *

And each month new features will be added—and occasionally some will be taken off.

* *

The Editor invites our readers to send him their opinions—especially their ideas for making this "honor list" bigger and better and more useful.

* *

Here is a letter from a reader of Popular Radio that tells its own story; it comes from M. J. Isler of Hoboken, N. J. As his experience checks up with the Editor's own (he also has an LC-27 in his home), Mr. Isler comments are here given *verbatim*:

"Here is my frank opinion of my LC-27 receiver; I shall be glad to have you broadcast it through your periodical so that my fellow fans may realize what their good money can buy for radio entertainment in place of some of the junk most fans seem to get.

* *

"Forty-eight hours after I got a good look at the LC-27 at the Radio Show in New York last September and had obtained an advance copy at your booth, my receiver was completed—power-pack and all—(I had been using the Amertran 'B' power and audio transformers for months with the LC-26).

* *

"Needless to say the outfit has been functioning day after day ever since.

* *

"My apparatus is identical to the parts used in the description by Mr. Cockaday except that I use a storage 'A' battery and trickle charger for my filament supply.

* *

"During my many pleasant evenings spent listening to real honest to goodness music, I recalled my many radio tours of the shopping districts and came to the following conclusion:

* *

"It is a real pity that only a small percentage of the radio fans throughout the country avail themselves of the opportunity to obtain something really worth while for their home pleasures. I look at it somewhat like this:

* *

"Here comes Mr. So-and-So, who creates this or that circuit and then goes on to explain how to synchronize this thing and how to vary the other thing, how to balance the next thing and after leaving the reader to guess where to throw his parts on the baseboard and panel, he seems to say, 'There it is, the best circuit ever put out, go to it!' And a few thousand fools go right to it and then wonder why the completed dishpan producer doesn't act as outlined! But then it's too late; the money is gone and he's got to commence all over again.

* *

"Laurence Cockaday is a real friend of the radio fan. Does he fill the air with a lot of ridiculous claims? Does he give you a few hundred complicated calculations to endure in order to make a set really work? He does not. He thoroughly covers every detail of construction, creates a circuit that will work as well for me as it will for himself—if one can but read English and handle a soldering iron.

* *

"I've built all of Mr. Cockaday's creations in the broadcast receiver line and the result is always a set to be proud of; they function exactly as outlined and claimed by him in every respect.

* *

"The results obtained with his LC-27 are truly remarkable; I defy anyone, anywhere, at this time to name a single receiver which will equal or excel the reproduction obtained with the LC-27. I've heard them all, from the crystal set up—and the LC-27 stands supreme.

* *

"He just tells you very concisely how to place the apparatus, how to wire it and how to operate it.

* *

"I've built a dozen of these LC-27 receivers for my friends, and no one can tell one from the other when listening to a program; some are operating as far west as Los Angeles and as far south as Miami, with equally unsurpassable results. If you don't believe it, drop in and hear mine!"

* *

From an ardent English radio experimenter comes this friendly slap on the back:

"I think Popular Radio gives the most useful, practical, interesting and bang-up-to-date information—and I don't mind who knows it!"

Derek Shannon, F. R. S. A.
(G5CG and G5PX)

* *

How to reduce interference with a device known as the "Pre-Selector"—another development of the Popular Radio Laboratory—furnishes the basis of an important contribution to the next issue of this magazine,

* *

This unit, which may be used with *any* receiver, is designed to overcome the general interference that is usually suffered in districts where several broadcasting stations are in simultaneous operation. It is connected between the receiver and the antenna, and it provides a degree of selectivity heretofore obtainable only with the finest superheterodyne sets.

Kendall Banning

Editor, Popular Radio.

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Bachrach

The Excellent Balance Between Technical and Popular Articles in POPULAR RADIO

"POPULAR RADIO is a very welcome visitor to our office each month. You certainly are to be congratulated on the excellent balance maintained between technical and news material, as well as on the selection of topics to be covered. A reader of POPULAR RADIO *is given, in an interesting way, the most important developments in radio science as well as entertaining articles on various related subjects."*

Lawrence K. Marshall

GENERAL MANAGER RAYTHEON MFG. CO.

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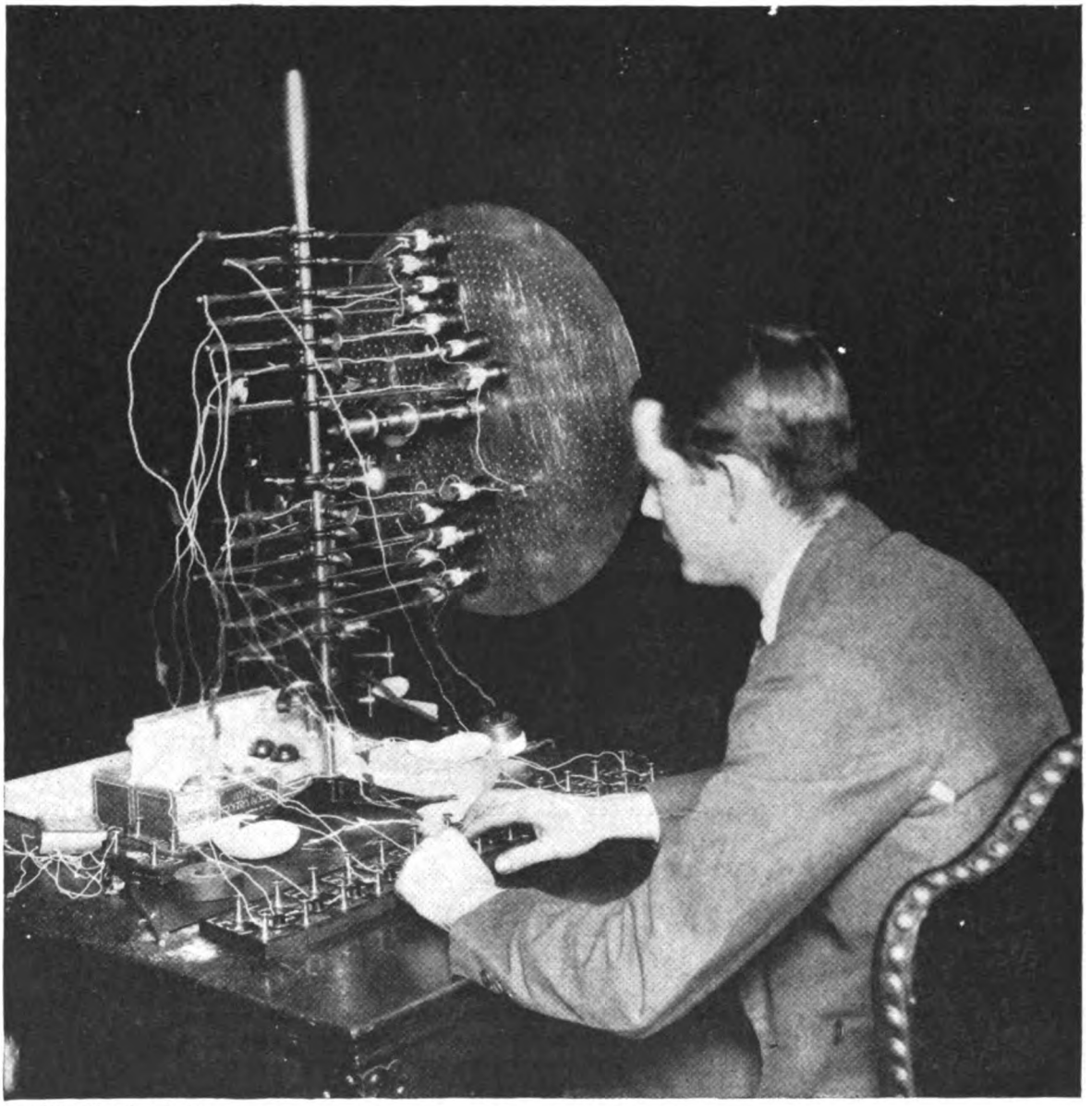

New York Electrical Society

Carrying Music On a Ray of Light

The New York Electrical Society, well known in the Metropolis for the interest of its programs of popular science, listened recently to the newest scientific and musical novelty, the "photoelectric organ," demonstrated by Dr. E. E. Free and Dr. Norman Hilberry. Light rays, shining through the holes in the rotating disc, produced interrupted pulses of light like the pulses of air in an organ pipe. Dr. Hilberry is shown above operating the switches which light the lamps; one lamp and one series of holes corresponding to each musical tone. The light ray, with its musical message, crossed the platform of the Society, was received on a photoelectric cell and converted by radio amplifiers into the audible music. Chords and other tonal combinations were played. When anyone stepped in the path of the light way, the music instantly ceased.

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Popular Radio

VOLUME XI April, 1927 NUMBER 4

The Three Blankets Around the Earth

Radio, like life itself, is possible only by the aid of the air. It is not the *lower* air which we breathe that is effective in radio, but the *upper* air—fifty to one hundred miles above the ground. There are three layers of this upper air and, curiously enough, it is the middle layer, not the outermost one, which is the coldest. This article tells of some of the newest scientific discoveries concerning these three concentric layers of gas around the earth.

By E. E. FREE, Ph.D.

IF you take an orange and wrap around it as tightly and smoothly as you can a sheet of ordinary linen writing paper, that will serve with reasonable exactness as a model of our earth and its air.

The sheet of paper will not be quite thick enough to represent all of the atmosphere, for there are traces of gas that venture up, we imagine, to heights of several hundred miles above the ground. But one thickness of writing paper will represent, if the earth itself is the three-inch orange, the thickness of the only part of the atmosphere which is now known to have any great importance to man. The outer surface of this paper wrapping will correspond, in its distance from the actual rind of the fruit, to the distance of the famous Heaviside Layer above the ground.

It is no longer necessary to remind the radio public how important this Heaviside Layer is for the science and art which interest us. Long-distance radio is made possible by the Heaviside Layer. Were it not for the conducting path which this Layer provides, thus causing the waves to curve around the earth instead of going off in straight lines through space, the trans-Atlantic radio telephone would be an impossibility. Even broadcasting over the land would probably reach only a few hundred miles, instead of the thousands of miles which now constitute the nightly records. Other supposed manifestations of the Heaviside Layer, such as fading and the "skip-distance" effect, are not quite so popular amongst the fans, but no one will deny, even in his darkest moments when some much-desired station has just faded out, that the benefits which we owe to that radio-carrying layer far up in the air are far greater than the ills it sends us.

The numerous investigations of the path of radio waves in the upper air which have been carried out in recent years, notably by Drs. Breit and Tuve of the Carnegie Institution of Washington, have given us reasonably accurate estimates of the height of the Heaviside region above the ground. It seems to lie at elevations between 30 miles and 50 miles; higher at night than in the daytime and with some variation from season to season. This refers, of course, to the lower surface of the layer. Above that level there exists an unknown thickness of atmosphere which possesses the significant property of being a good conductor of electricity and thus of passing our radio waves easily from one side of the earth to another, or, indeed, entirely around the terrestrial ball and back again.

To return to our orange with the paper wrapped around it, the outer surface of this sheet of paper corresponds to the under surface of the Heaviside Layer. Add a second wrapping of thicker paper, like blotting paper and that will correspond reasonably well to the thickness of the Heaviside Layer itself, the layer that carries our radio waves. It would be more correct to procure, were it possible, some kind of blotting paper composed of the most delicate and flimsy fiber, for the gases of the air at the height of the Heaviside region are almost as thin and tenuous as are the remnants of gas left inside the vacuum tube of a radio set.

Exactly how tenuous these gases are we do not know, for the electric and radio-carrying properties of this roof of the earth's atmosphere are far better known than almost anything else about it. It is impossible, unfortunately, to go up and visit it. The highest flights of airplanes and balloons have reached only about seven miles above the ground. Smaller balloons, carrying recording instruments but no human observer, have attained heights up to 24 miles. The man-made object which has been highest into the air in the history of the earth so far is probably some one of the shells fired at Paris during the World War from the great guns which the Germans mounted seventy-odd miles away. These

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shells are believed to have risen to heights of nearly thirty miles above the ground—but unfortunately they brought back no messages of what they encountered.

Our actual knowledge of the atmosphere ceases, therefore, at less than one half of the height which has been fixed upon by radio tests as the lowest position occupied by the lower surface of that Heaviside region which most interests the radio engineer. Nor is there much hope that this lack in our direct knowledge will soon be repaired. It is true enough that Professor Goddard's rocket, many times described in POPULAR RADIO, would be quite competent to rise to fifty miles above the ground, or even to three or four hundred miles, and to bring back samples of the upper atmosphere. But the rocket has not been built, although it is undeniable that some one ought to provide funds so that it can be. At present, when we wish to know what exists in that upper air which is so important to all modern theories of the movement of radio waves, we must fall back upon such indirect evidence as we can procure in other ways.

The earth is frequently said to possess a "blanket" of air which keeps us tender humans warm against the cold of outer space. The metaphor is a good one, but the bed is better covered than that. Instead of one blanket wrapped around us we have three, one outside the other. And it now begins to seem probable that of these three protective layers the outermost one, not even dreamed of as existing until a few years ago, is probably the best of them all.

The layers of air immediately next the ground are subject—as who can forget?—to the continual excitement which we call weather.

Cold waves and hot waves come to plague us. The spasms and convulsions of storms arrive to vary the succession of chills and fevers. It is by no means a restful ocean of air at the bottom of which we are condemned to dwell. The small instrument-laden balloons which meteorologists can send up far higher than human aeronauts dare venture, tell us, however, that this restlessness does not last all the way up through our air. At a crucial height of about seven miles the small balloons enter the second of the earth's blankets, the one which meteorologists call the "stratosphere" or the "isothermal layer."

The word isothermal refers to the curious and unexpected fact that this middle one of our three blankets is of very nearly the same temperature throughout, a temperature of about 80 degrees or 90 degrees below zero, Fahrenheit. That the air grows colder as one goes up the slopes of high mountains is well known. The same observation is made by aeronauts in balloons. There are very few places on earth, if any, in which one can be colder than in an airplane or a balloon four or five miles above the ground.

But at the bottom of the middle air blanket this fall of temperature ceases. At eight miles, at ten miles, even at the twenty-four miles which is the greatest height from which any balloon-lifted instruments have come back to us, the temperature remains still at that eighty or ninety degrees below zero which it had reached at a height of seven miles or so when the balloon entered the second blanket. The outer cold of space, after one has left the earth's atmosphere

Brown Brothers

One Space Visitor That Penetrated Our Blankets

Nearly all of the meteors that hit the earth's air blanket from outer space are so small that they burn up instantly, making merely a streak of light in the sky. An occasional one is larger, survives the fiery experience forced on it by the air blanket and reaches the ground. This makes what scientists call a meteorite—a meteor that hits the earth. This meteorite was found near Willamette, Oregon, and is now in the Museum of Natural History, New York City.

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altogether behind, is believed to approach what is called the absolute zero, a temperature which has been very nearly reached in our physical laboratories and which is calculated as approximately 460 degrees below zero, Fahrenheit. Why is the air of the earth's second blanket kept so warm? Cold as it is—for ninety degrees below zero is by no means a pleasant warmth according to human standards—this middle blanket is far warmer than the enormous degree of frost which we have always believed exists not so many hundreds of miles outside it.

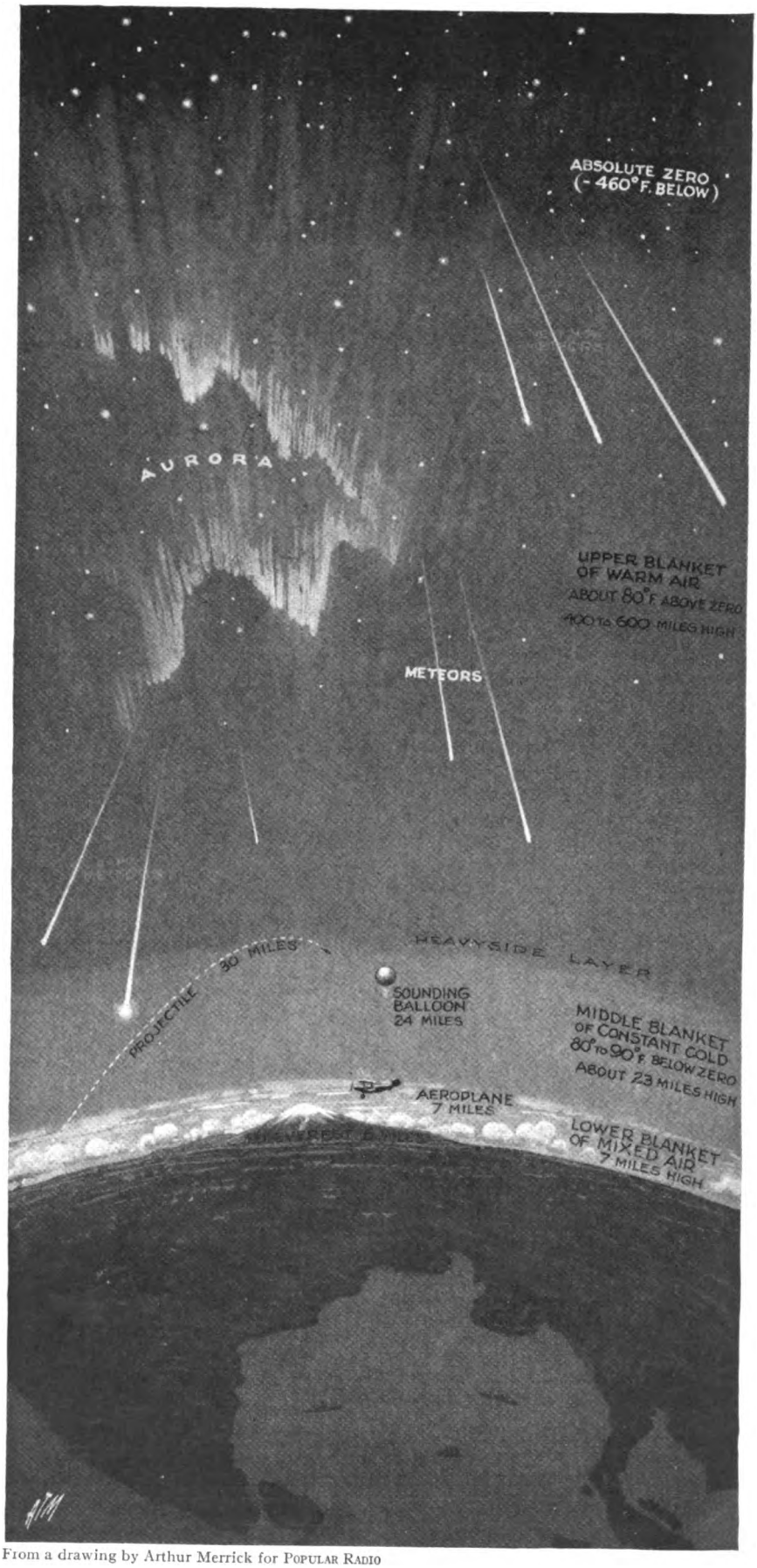
The explanation is to be found, the meteorologists believe, in the properties of the third blanket; the one which wraps the earth on its very outside and which serves, most efficiently indeed, to repel the outer cold of space.

It is this third blanket, too, which acts as the Heaviside Layer, for there is good reason to believe that it begins at just about that same level of fifty miles above the ground which is indicated by the radio tests as the probable under surface of the Heaviside region.

Since this third and outermost blanket of air has never been reached by any kind of balloon, airplane or other man-made contrivance, not even by the shells from the big German gun, we must depend for what we know of it on indirect information. We actually do depend, in fact, on watching the bullets which comets are continually firing at the earth and which this outermost blanket of our air does us the enormous service of stopping. These bullets are the meteors, those flashing streaks of fire in the sky which we call "shooting stars."

These meteors hit the earth's atmosphere at the rate of many thousands each day. Most of them are small, probably not averaging larger than the size of a grain of sand. But they move at enormous speeds, often as great as twenty or thirty miles a second. They are believed to be the debris of comets, scattered in enormous numbers through the space which the earth must traverse each year in its journey around the sun. Some are iron; others are of stone. If one of them hit a man it would go through him, or through a dozen men, like the bullet from a superlatively powerful machine gun. It is probable that if our air blankets failed for a single year to protect us against this continual bombardment there would not be a man, woman, child or animal; perhaps not even a plant; left alive on earth.

But our outermost blanket of air not only saves us from these celestial missiles by stopping them and burning them up, it also provides us as it does so with a great many facts about its own nature. For many years scientists have been ob-



From a drawing by Arthur Merrick for POPULAR RADIO

What Happens Over Our Heads

In the uppermost blanket of warm air occur the auroras and most of the visible tracks of meteors. The other blankets are also shown.

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serving the shooting stars. That is how it was discovered, for example, that these spectacular visitors are related to the comets and are probably composed of cometary debris.

Beginning some years ago, two English scientists, Professor F. A. Lindemann and Mr. G. M. B. Dobson, have carried this study much farther.

They photographed the light streaks made by meteors, using two cameras at some distance from each other. Thus they determined the heights at which each meteor first appeared and the heights at which each one disappeared. They calculated the sizes of the solid projectiles which burnt up to produce the streaks of light. They estimated the brightness of each streak, and from this the amount of energy which was set free by the combustion of the metallic projectile. They won not only a vast increase of our knowledge of the meteoric projectiles themselves, but also some substantial nuggets of fact about the air which the meteors enter and which sets them on fire by its friction.

The most startling fact about this outermost of our air blankets is the fact that it is not cold. Indeed, it is far warmer than the middle blanket and may even be as warm as the inmost air which we ourselves breathe. The calculations seem to prove conclusively that the upper levels of the air are always warm. In his latest pronouncement Professor Lindemann favors a temperature of about 80 degrees above zero, Fahrenheit; that of a warm summer day on the earth's surface.*

This is a remarkable circumstance, but consideration of the probable composition of the upper air renders it less surprising.

The uppermost levels of the atmosphere probably contain some oxygen. This oxygen is exposed to the intense light of the sun, containing a larger percentage of the very active ultraviolet rays than sunlight contains after it has been filtered through the three superposed blankets of our air and has reached the earth. These ultraviolet rays convert much of the oxygen into its modified form which we call ozone. There is sure to be a relatively large percentage of this ozone in the uppermost layers of the air.

Ozone has a remarkable ability of absorbing sunlight and of holding on to it. It is probable, Professor Lindemann and Mr. Dobson believe, that the ozone absorbs enough sunlight to keep the upper layers of air warm. That is one reason why the middle blanket of our atmosphere is less cold than the absolute zero of outer space. It has a still warmer layer of air above it.

Such chemical changes in the uppermost layers of air as the production of ozone from oxygen would have the greatest importance for our theories of radio if we but knew what other gases are present in that outermost blanket, together with the oxygen. It is this outermost blanket we must remember, which constitutes the Heaviside Layer. Presumably the high electric conductivity of that layer is due to atomic changes of the nature of ionization, resulting in electrified atoms; changes of exactly the same kind as those experienced by the atoms of oxygen on their way to become molecules of ozone. It is very probable that the same ultraviolet rays which produce the ozone and thus permit that outer air to keep us warm, are effective, also, in producing the ionized atoms which keep our radio waves on the move.

All these matters we could calculate, probably with considerable accuracy, if we knew exactly what kinds of atoms are there and how many of each. Fortunately, there is an excellent chance that we will be able to find out. There is another well-known phenomenon which occurs in these same uppermost levels of the air. This is the Aurora or "Northern Lights."

For many years a distinguished Nor-

(*Continued on page 397*)

U. S. Signal Corps

Recorders for the Heavens

Lieut. John A. Macready, noted aviator and holder of records for altitude, is shown with some of the recording and indicating instruments that airplanes carry on flights to the highest points which they can reach; still, well below the level of the Heaviside Layer, as shown on page 329.

* "Meteors and the Constitution of the Upper Air," by F. A. Lindemann. *Nature* (London), volume 118, pages 195-198 (August 7, 1926). A recent lecture by Mr. G. M. B. Dobson, published under the title, "The Uppermost Regions of the Earth's Atmosphere," Oxford Press, England, 22 pages, 1926, embodies the same information.

Photographs by Mr. W. B. Housman

Three Remarkable Photographs Made by the Light of the Aurora

On October 15, 1926, there occurred over the north of England and of Norway one of the most remarkable aurora displays ever seen. The streamers and curtains of electric fire were photographed by Mr. W. B. Housman, at Cumberland, England, who kindly permits POPULAR RADIO *to present the three views reproduced above. On the left is a view of the west end of the auroral arch at about 10* P. M. *In the center is the same region about three hours later. The narrow lines of light in the sky are made by the motion of the stars, the plate being exposed for some time in order to record the faint light of the aurora. At the right is the central portion of the auroral arch at about 1.30* P. M.

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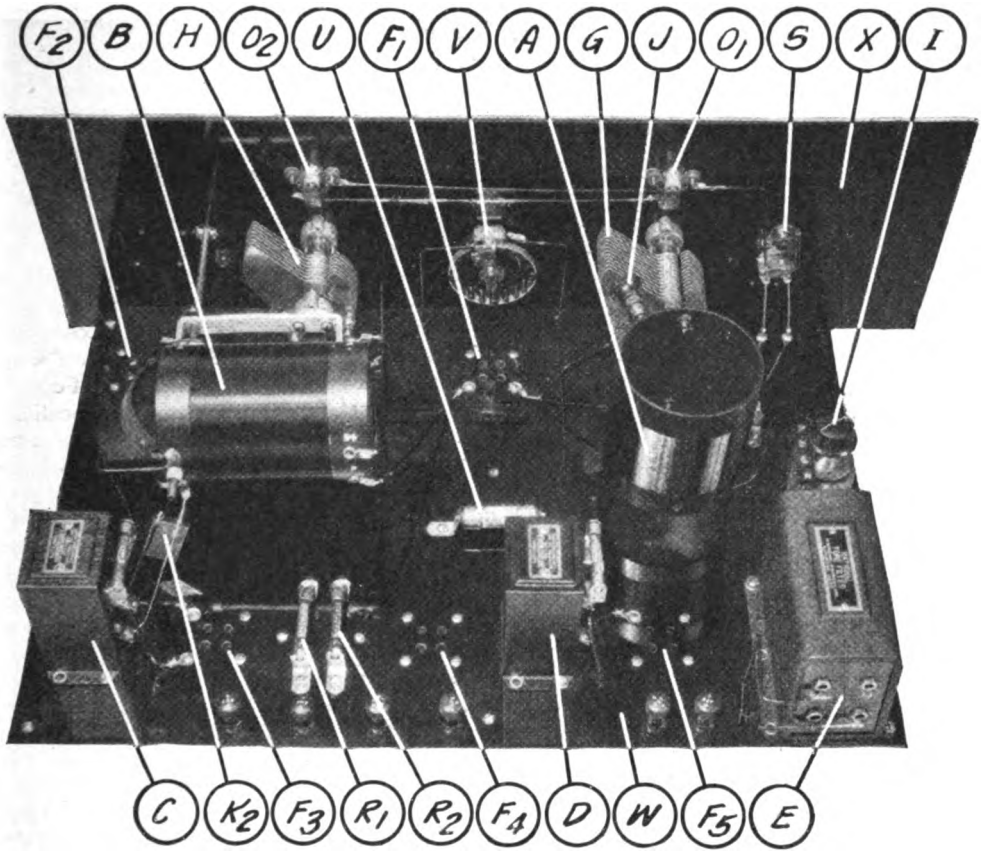

A REAR VIEW OF THE COMPLETED RECEIVER

FIGURE 1: *This picture shows how the instruments are mounted on the panel and on the top side of the bakelite baseboard. Notice that the binding posts are mounted along the rear edge of the baseboard; the sockets are riveted directly to the base.*

HOW TO BUILD THE NEW STANDARD

Browning-Drake Receiver

Complete details of the design and construction of the latest and best Browning-Drake Receiver—best both in all-around efficiency and in tone quality—are given here for the first time in this article written exclusively for the readers of POPULAR RADIO by the inventors—

GLENN H. BROWNING and DR. FREDERICK H. DRAKE

COST OF PARTS: *Not more than $87.00*

HERE ARE THE PARTS THAT ARE USED IN THE NEW BROWNING-DRAKE RECEIVER—

A and G—Coil and condenser, comprising the new Browning-Drake antenna tuning unit;*

B and H—Coil and condenser, comprising the new Browning-Drake high-frequency tuning unit for input detector;*

C—National Impedaformer, first stage, equipped with Lynch resistor;

D—National Impedaformer, third stage, equipped with Lynch resistor;

E—National tone filter;

F1, F2, F3, F4 and F5—Tube sockets (these are part of the equipment of the subpanel);

I—Precise midget variable condenser, .0001 mfd.;

J—Browning-Drake balancing device;

K1, K2 and K3—Any approved fixed condensers, .001 mfd. (Tiny Tobe fixed condensers are here illustrated);

L—Any approved fixed condenser, .00007 mfd. (Tiny Tobe fixed condenser is here illustrated);

M—Any approved by-pass condenser, 1 mfd. (Tobe by-pass condenser is here illustrated);

N1, N2, N3, N4, N5, N6, N7 and N8—Any approved binding posts, marked respectively, *Ant.*, *Gnd.*, *A—*, *A+*, *B+ Det.*, *B+ Amp.*, *C—*, *C+* (Eby binding posts are here illustrated);

O1 and O2—Pilot lamps attached to tuning dials, Y1 and Y2;*

P—Tobe special type condenser, .1 mfd.;

Q—Any approved resistor, 8 megohms (Electrad resistor is here illustrated);

R1—Any approved resistor, .1 megohm (Electrad resistor is here illustrated);

R2—Any approved resistor, .25 megohm (Electrad resistor is here illustrated);

S—Yaxley filament switch, equipped with Browning-Drake knob;

T—Browning-Drake resistor, 33 ohms;

U—Any approved automatic filament control for 1¼ amperes (Brachstat control is here illustrated);

V—Any approved 30-ohm rheostat (Yaxley rheostat is here illustrated);

W—Browning-Drake sub-panel, drilled and engraved and equipped with sockets, resistor clips and soldering lugs;†

X—Browning-Drake front panel, drilled and engraved;†

Y1 and Y2—National illuminated vernier dials.*

1 set of POPULAR RADIO blueprints.

*These parts are contained in the Browning-Drake kit.

†These parts are contained in the Browning-Drake foundation unit.

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¶ The list of parts given on page 331 includes the exact instruments used in the unit from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by POPULAR RADIO *which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

THE past three years have brought forth no real fundamental changes in radio circuits. But they have brought forth improvements in the circuits and in the apparatus used, both from the standpoint of electrical efficiency and mechanical design.

The tendencies in radio today are toward:

1. Simplicity of control.
2. Better reproduction.
3. Operation of the receiver from the electric-light circuits.

Of course, the receiver must have other essentials; it must have, for example, selectivity sufficient to cope with the present broadcast situation and to allow the reception of distant signals when such are available.

The set described in this article may be operated with batteries or from the electric-light socket. It has two major controls; it is selective and sensitive; and it incorporates a low-frequency amplifier with excellent tone quality.

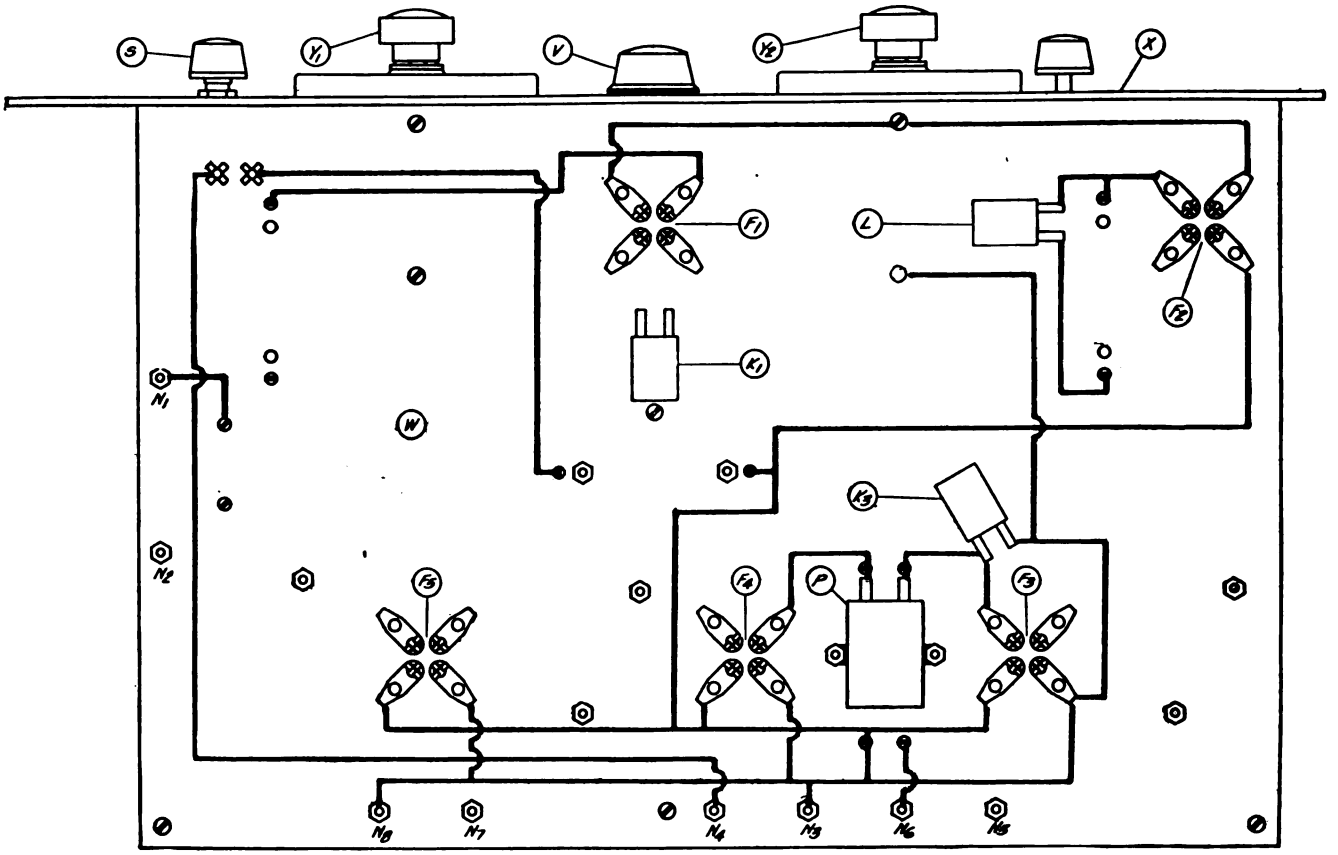
This circuit is built around an efficient tuned-high-frequency transformer developed at Cruft Laboratories, Harvard University, by the authors. This high-frequency amplifier design has been brought up to date in every detail. A few minor improvements, which are the result of constant work on the set, have also been incorporated. One of these is an improved balancing system which has the advantage of being more nearly constant over a band of wavelengths from 200 to 500 meters. The selectivity of the circuit has been much improved, so that tuning, in the face of the present crowding of stations, may be accomplished to better advantage.

One stage of tuned-high-frequency amplification is used in conjunction with a regenerative detector unit.

The condensers and coils have been improved from an electrical standpoint and also from a mechanical standpoint. The coils are wound on a 3-inch form with enameled wire, spaced one-half a diameter, which reduces the total high-frequency resistance to a minimum value as determined by Mr. Richardson, working on the problem at the Massachusetts Institute of Technology.

A combination low-frequency amplifier, consisting of one stage of impedance-coupled amplification, one stage of resistance-coupled amplification and a final stage of resistance-coupled amplification with an impedance leak, was chosen as a result of long experiment. This type of low-frequency amplifier not only preserves all of the qualities of resistance and impedance amplification, but it seems to be more stable in its operation when used with "B" power-packs, and it is therefore better suited to the AC-operated receiver.

The apparatus has been laid out so as to incur the least possible interaction troubles. Ample space has been left between the two tuning units for the high-frequency amplifier valve, and this arrangement allows for the shortest con-



A NEW IDEA OF A PICTURE WIRING DIAGRAM

FIGURE 2: *This new method of showing a picture wiring diagram will eliminate any confusion between wiring and instruments. The instruments are outlined here in black; the wiring is in red. This drawing shows the wiring underneath the sub-panel of the new Browning-Drake receiver.*

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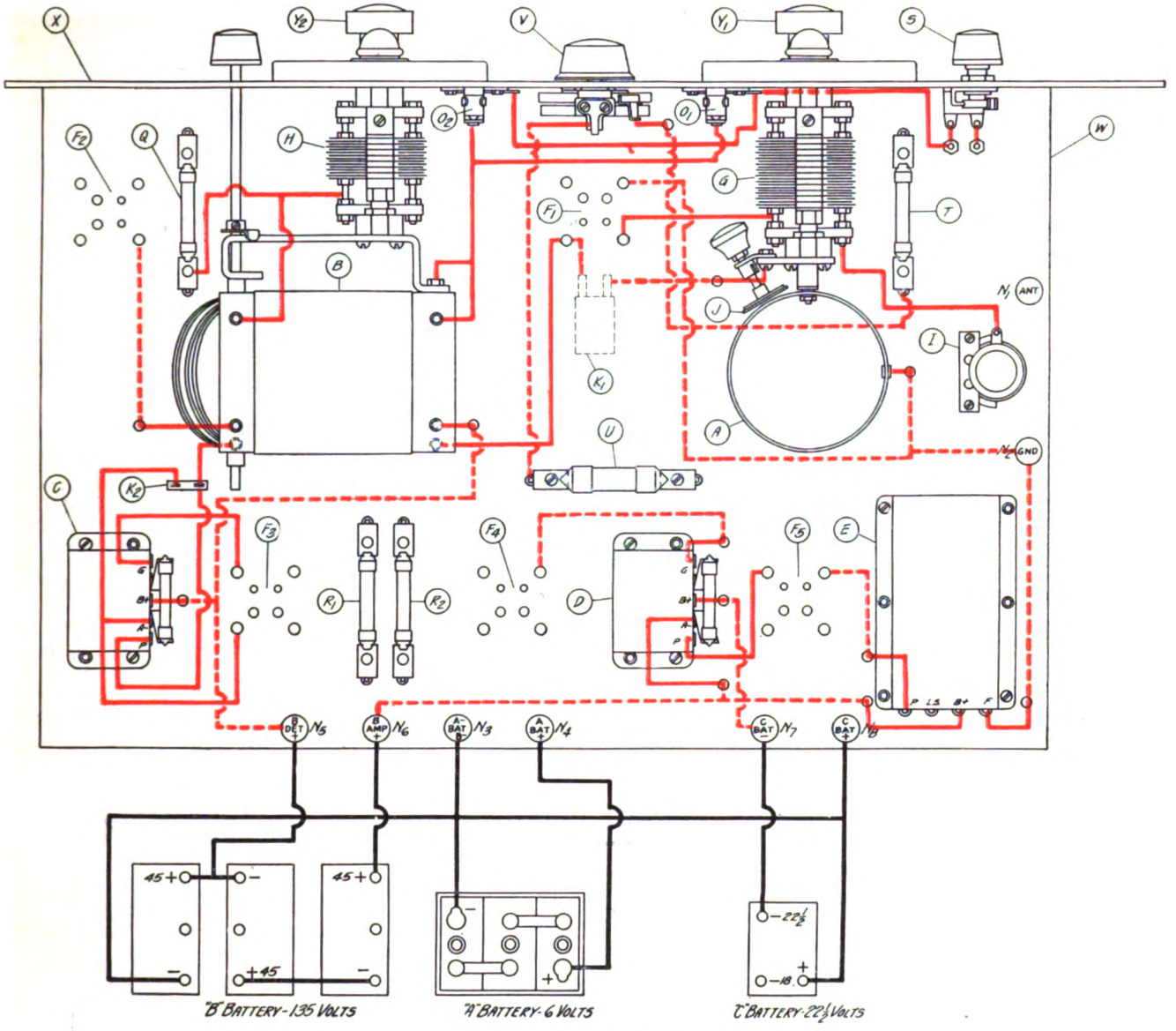

THE WIRING ON THE TOP SIDE OF THE SUB-PANEL

FIGURE 3: *The instruments drawn in solid black lines are fastened on top of the base; the condenser shown in dotted black lines is under the base. The wiring done on the top of the sub-panel is shown in solid red; the wiring that leads below the panel is in dotted red. The battery connections are also shown.*

nections for the high-frequency circuits. The detector is placed at the right of the condenser that tunes the transformer, and the low-frequency amplifier placed towards the rear to reduce similar coupling troubles.

Care has been taken not to place any of the apparatus too close to the coils, as this tends to increase their resistances and to make the tuning broader.

The tuning is accomplished by means of two new-type illuminated dials. In addition to these two dials, a filament switch, a 30-ohm rheostat for controlling volume and another knob, which rotates the tickler coil, are located on the front panel.

The circuit diagram of this Browning-Drake receiver is shown in Figure 6.

How to Construct the Set

As the front panel, X, and the sub-panel, W, may be obtained already drilled, little constructional data is necessary if the photographic illustrations and schematic diagrams are followed.

Mount all of the instruments on the sub-base, W, as indicated in Figures 1, 2, 3, 4, 5 and 7.

In wiring up, it might be well, however, to enumerate the most important connections that should be kept well away from the other connections—

1. The connections from the antenna binding post, N1, to the midget condenser, I, and the connection from this condenser to the stator plates of the first tuning condenser, G.

2. Connections between the coils, A and B, and the condensers, G and H (these carry more high-frequency currents than any other leads in the set).

3. The connection between the stator plates of the first condenser, G, and the grid of valve, F1.

4. The connection between the plate of the high-frequency valve, F1, and the primary of the high-frequency transformer, B.

5. The connection between the stator plates of the second tuning condenser, H, grid-leak, Q, and condenser, L.

6. The connection between the grid-leak, Q, and the condenser, L, and the grid terminal of the detector valve, F2.

It will be noted that the specifications for the third low-frequency stage of amplification called for an impedance in re-

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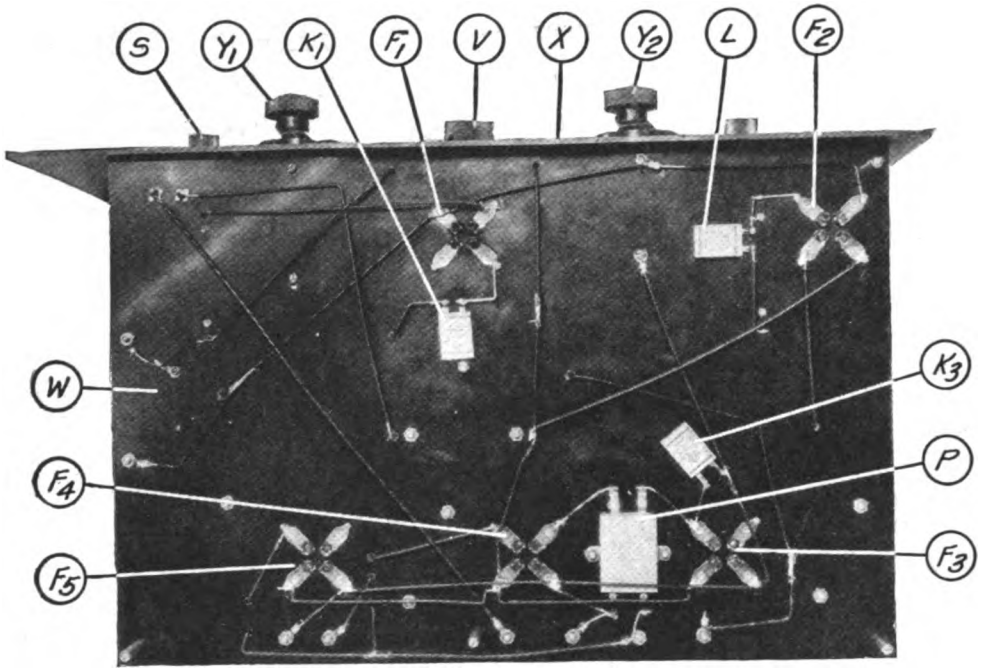


A VIEW OF THE SET FROM BELOW

FIGURE 4: *This view shows the bottom of the baseboard and the condensers and socket prongs that are mounted on the under side.*

versed position. The Impedaformer unit, D, was designed to accomplish this purpose.

In all the wiring work, it is advisable to make all high-potential connections first, that is, the connections to the grid and the plate terminals of the vacuum valves.

The new receiver is intended primarily for operation with regular 5-volt vacuum tubes except in the high-frequency amplifier, where a UX-199 type valve should always be used. This vacuum valve was chosen for the high-frequency amplifier on account of its small plate-to-grid capacity and the ease with which it is balanced. A resistance, T, of 33 ohms is placed in series with this tube's filament; this reduces the 5 volts, applied to all the other tubes, to 3 volts for this special high-frequency tube.

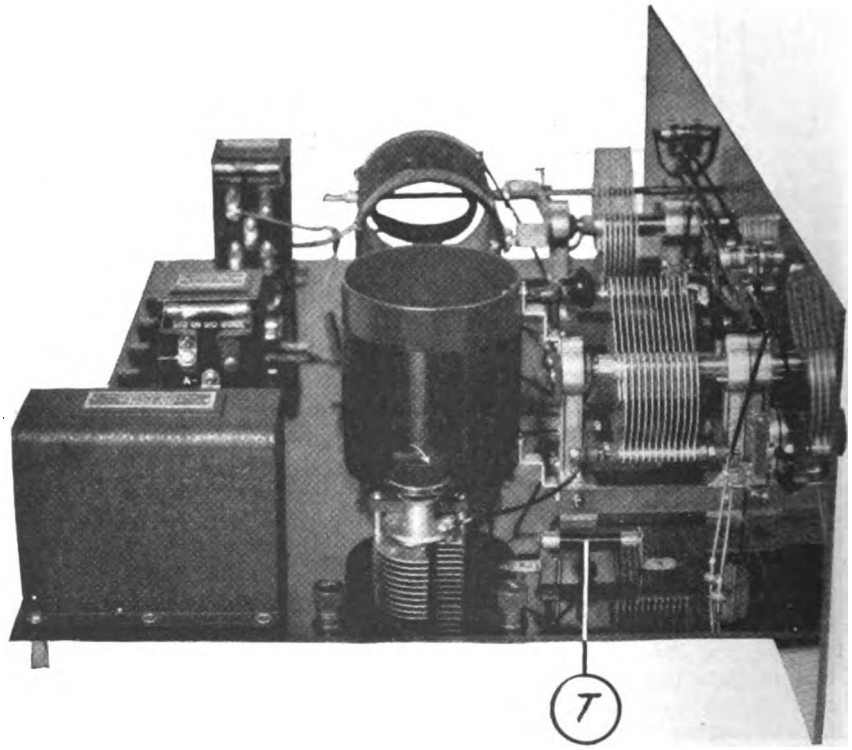
A 30-ohm rheostat, V, which is variable, is used solely as a volume control and may be turned completely on when maximum signal strength is required.

For the detector, a UX-200-a type vacuum valve has been chosen on account of its high sensitivity. The grid return on this valve is run to the negative side of the filament, as shown in Figure 6.

If the constructor desires to use a UX-201-a type valve as a detector, the grid return should run to the positive filament instead.

For the first two stages of low-frequency amplification High-Mu valves of the Daven, Zetka, Truphonic or Ceco types may be used, or if such great amplification is not necessary, regular UX-201-a type valves are satisfactory. The former sometimes have slight tendencies to ripple, or cause what is commonly known as "motor boating" in such an amplifier. This is an unstable oscillation occurring when used with some "B" power-packs. This trouble may be remedied in a number of cases by using one High-Mu tube and one regular UX-201-a type valve.

In the last stage of low-frequency amplification, it is essential to have some type of power valve, if the builder desires to deliver a large amount of un-



HOW THE SET LOOKS FROM THE LEFT

FIGURE 5: *The general method of mounting the output filter, the condensers and coils and the small, midget, variable condenser for the antenna circuit is shown here.*

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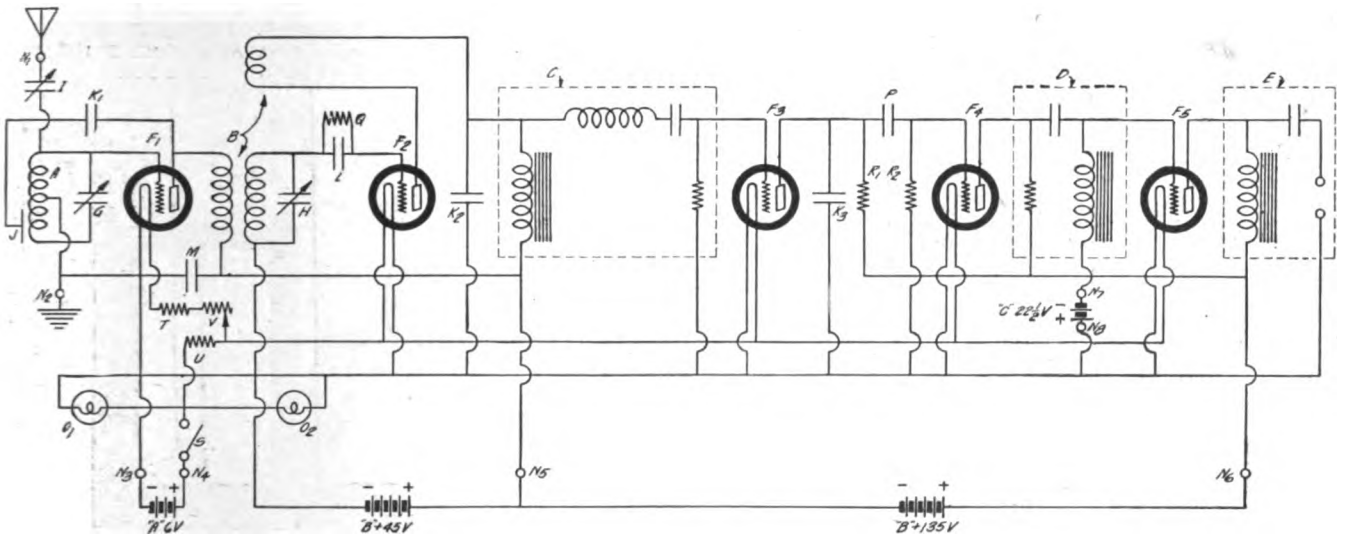
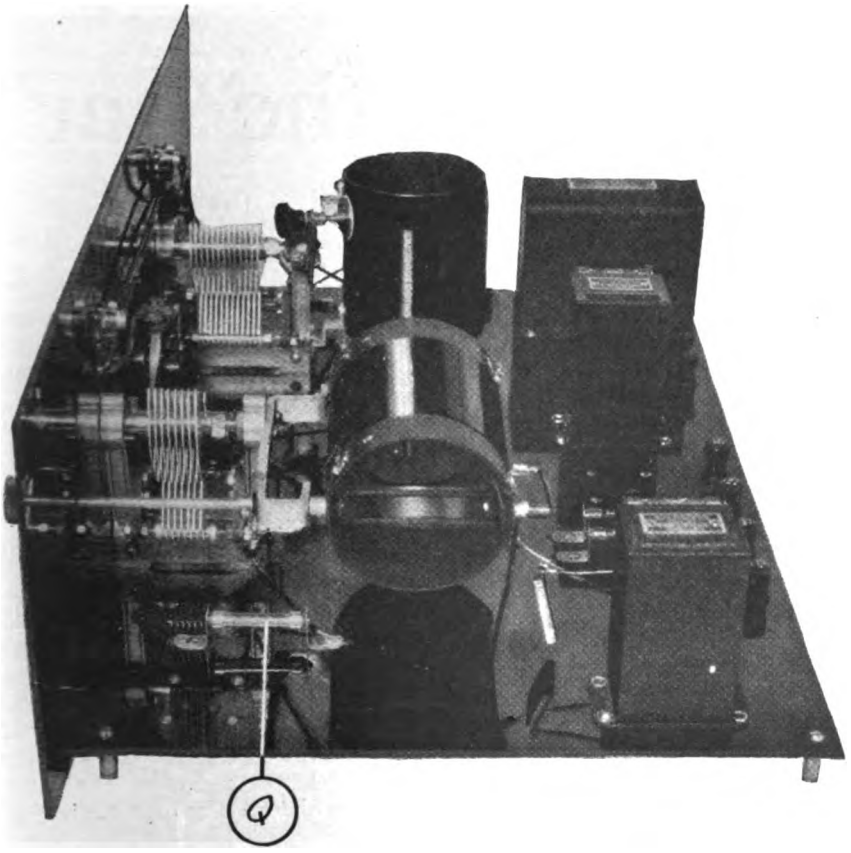


THE SCHEMATIC CIRCUIT DIAGRAM

FIGURE 6: *One stage of high-frequency amplification balanced by a simple neutralizing scheme is used together with a regenerative vacuum-tube detector, one stage of impedance-coupled amplification, one stage of resistance-coupled amplification and a final stage of resistance-coupled amplification with an impedance leak and an output filter.*

distorted volume to the reproducer. The last valve is really the only place in the set where power is an important factor. Valves of the UX-171 type have a plate impedance which more nearly matches that of good cone reproducers than that of other type tubes.

An output system, E, consisting of a low-frequency choke coil combined with a fixed condenser of about 4 mfds., keeps the DC power from flowing through the windings of the reproducer but allows it to feed the plate circuit of the last valve, F5.



A VIEW OF THE SET FROM THE RIGHT

FIGURE 7: *This additional view of the receiver shows again the simplicity and neatness of its design.*

This is desirable, in most cases, as it improves the tone quality at the same time that it protects the reproducer.

How to Operate the Receiver

When the set has been constructed according to the diagrams and photographic illustrations it is ready for installation.

Connect the set up, as shown in Figures 2 and 3, to the batteries, to the antenna, to the ground, and to the reproducer.

When the battery switch is turned "on" and all the tubes are in place, a slight "plop" should be heard upon touching the finger to the grid terminal of the high-frequency transformer, B, when the rotor coil is turned all the way up. This is a test for oscillation in the secondary of the high-frequency transformer. With the tickler coil set in this position, station whistles should be heard upon rotating dial Y2, if any broadcasting station is operating.

To balance the high-frequency tube, which is the one in socket F1, a station should first be tuned in. Then the rheostat, V, should be turned completely "off" and, if the station is a loud, local one, it will still be heard.

The balancing condenser, J, should then be adjusted until a *minimum* signal is obtained; the first tube, F1, will then be properly neutralized. When the balancing condenser, J, is set correctly, a change of the setting of the first dial, Y1, should not change the pitch of the whistle obtained in the detector circuit that operates on tube F2. Of course, the intensity of the whistle will be affected by the setting of the first con-

(*Continued on page 389*)

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ENGINE AND STEAMBOAT WHISTLE
ESCAPING STEAM
WHEELS ON RAILS
SHUFFLE OF DANCING FEET
CHURCH, RAILROAD, BOAT AND FIRE BELL
OPENING, CLOSING, LOCKING AND KNOCKING ON DOOR

General Electric Co.

The New "Drama of the Ear"

Some of the ingenious methods devised by the producers of plays broadcast from studios, to simulate the sounds that build pictures in the minds of the listeners

By CHARLES D. ISAACSON

TO the producer of "legitimate" plays, stage noises are merely incidental. But to the producer of plays that are broadcast from the studio, stage noises are the very essence of its action and the breath of its life.

The technique of the radio drama is becoming more and more complex and interesting in its possibilities.

With the advent of the drama in broadcasting, the query arose "how can this ever be successful? One cannot *see* the players, hence the most important aid for understanding the action is gone."

Not long before the advent of broadcasting the theatrical producers were convinced that motion pictures could never satisfy an audience, because the "most important aid for understanding the action was gone"—the sounds. But it was discovered that sounds can be seen as it is being discovered that seeing is possible through hearing. Of course, the motion picture has wisely preferred not to stand only on its own feet—a procedure not yet within the scope of broadcasting. It is for that reason that I am not sure that the radio theatre, at least before we have television, will ever succeed to the eminence of the screen play.

Motion pictures employ music to aid the action. The missing voices are simulated, if not materially improved through the emotion, action and speech, that is suggested by the harmonies of music and the supplementary "stage noises." In radio plays we have not so fine a substitute for the missing element of "seeing." Fortunately, however, it is possible to "see things" through other mediums than the eyes or the ecstasy induced by alcohol or drugs—such, for example, as the imagination and related ideas.

The purpose of the radio player is to give impetus to the "seeing" areas of imagination, memory and comparative suggestiveness.

This seemingly theoretical pronouncement can be easily explained; the sounds of knives, forks, plates, suggest, through the memory sense, the idea of eating. The radio impresario may quickly paint a dining room scene without the aid of canvas, if there are heard the dishes, the rattle of knives and forks, the chairs drawn to the table and the stirring of food.

If he punches a pillow during the relation of certain ideas in the conversation, a bed, a couch or a comfortable

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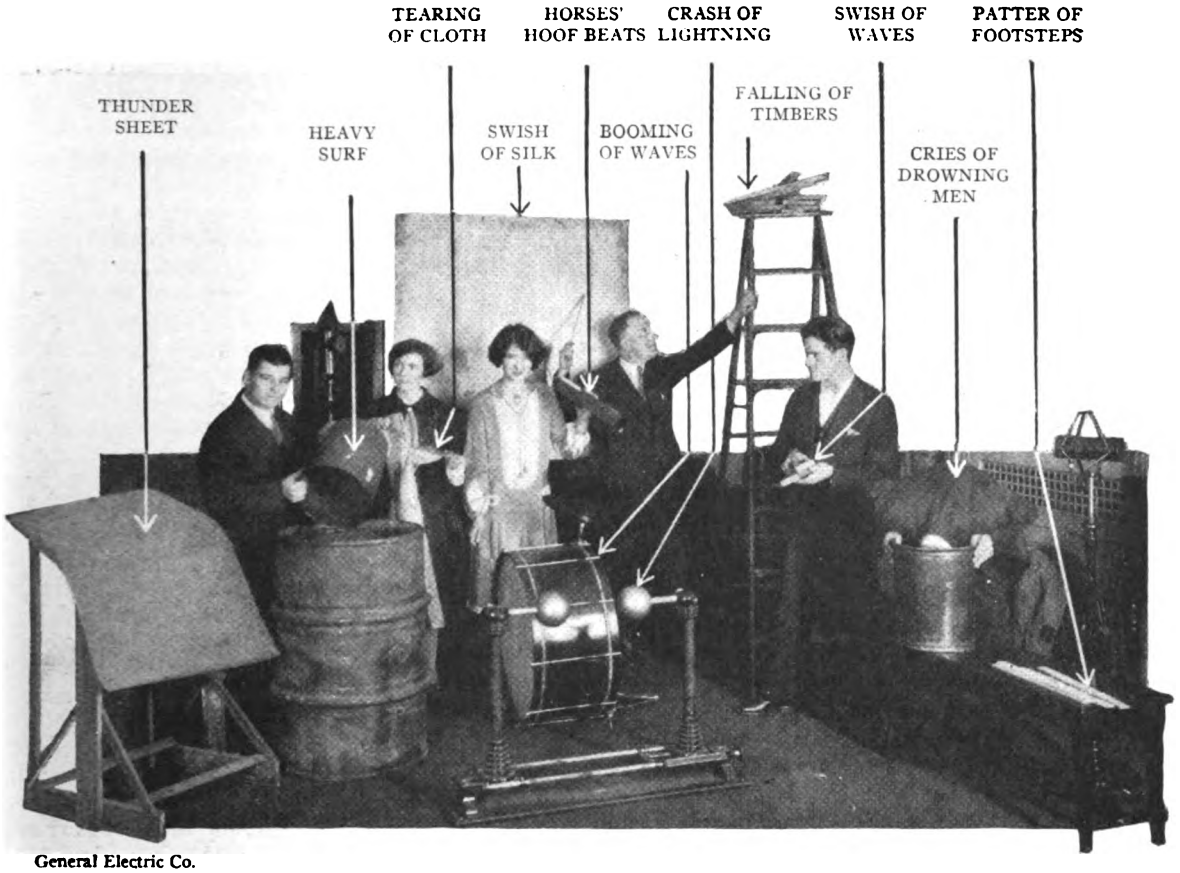

General Electric Co.

chair are pictured, according to the context of the lines in the play.

A fog horn tells of a dismal ocean scene, a rooster portrays the barnyard, a typewriter the business office.

So in the plays which are being broadcast the producers try to supply just enough sounds to stimulate the imagination and memory of the listeners.

This account of stage noises will not touch upon such commonplace sounds as the crashing of glass, the opening and closing of doors, the blowing of whistles, the ringing of the telephone, the galloping of horses, and the crashing of thunder, but upon the more subtle sounds.

During the broadcasting of my recent play, "Suppose It Should Happen," which was written with a radio presentation exclusively in mind, there is a tense situation. A husband and wife are awakened in the middle of the night to find in the elimination of every device of modern science that they are cut off from the world. They go to the telephone and it won't work. (The receiver arm of the telephone is heard to go frantically up and down.) The bell to the servants does not respond—but the listener can hear the push-button pressed. The electric light switch is useless, but the click of the switch with the helpless comment of the players are put upon the microphone. When the husband in a vain search for help goes down the steps, one can hear the tapping of the feet in the loose slippers gradually dimming away in the distance—a sound effected by a sensitive board and a floor mike. To get the effect of his voice yelling from the hall below, the actor muffles his cries by covering his mouth with his hand. It becomes necessary to find a way in the dark; matches were struck and finally candles were lighted and are blown out when daylight comes.

All these effects are real, and are created right up at the microphone. (Technical readers know that a whisper at the microphone may be a scream on the loudspeaker.)

What the producers of radio dramas seek to do is to give close-up effects similar to those used on the screen. So they enlarge the ordinary sounds, just as the movie director enlarges his scenes. The movie makes you feel more intensely the emotion by intensifying it by artificial means; that is what the radio producers are endeavoring to do with sounds.

When, for instance, a character looks at the clock and the question of the time is important, the clock is brought right up to the microphone. When a sob is the note which defines the action, that sob is the close-up. So is a cough or a laugh. Once a producer wanted the comedy of getting the chewing food across to the radio audience, so he had a noisy eater chew celery at the microphone. In a tense moment, when a character has nothing to say—only his anger, his fright, his utter bewilderment are to be expressed—his emotion is "pantomimed" by transmitting his hard, slow, staccato breathing as a close-up.

A letter should never be opened without the sound of its unfolding being heard. A newspaper should not be read without the rustling of paper.

Alice Brady, who starred in a radio play, assumed the rôle of a girl of long ago; she was supposed to wear a big hoop skirt costume of the period. Her dress was broadcast by the rubbing and swishing of a large piece of silk. Generally costumes are described or at least suggested by some phrase or sentence.

In the play "Suppose It Should Happen" (mentioned before) the husband and wife, frustrated by the absence of auto, train and street cars, resort to horseback to reach the city. It was all a dream, and to make the transition, the producers conveyed the sounds of the horses' hoofs getting slower and slower and finally timed exactly to the puff, puff, puff of a percolator which had been heated and brought up right close to the microphone!

Inasmuch as the Edison company's radio plays are based on scientific and particularly upon electrical subjects, the producers have naturally turned to sounds associated with that field. They have cleaned rooms with a vacuum cleaner, and used an electric curling iron; once when they were representing

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a woman heating a curling iron over a candle, they had one of the characters say "Be careful, the wax smoke has blackened that," and rubbed the iron with a paper to accentuate the scene. They never suggest an automobile before the microphone merely with a horn —the listener hears the motor going and the self-starter working. A sewing machine gives the effect of the motor while the car is at rest. They have even broadcast the sounds of bread toasting, corn popping, water boiling, eggs opened, and food being stirred on the stove. So also is the washing machine heard working.

Once the producers released a flock of pigeons in the studio to get a certain effect; at another time they had a dog and cat embroiled in a real, not a staged fight!

A real life play termed "It Can Be Done" which was broadcast, re-enacted the tragedy of Sol Rothchild, nearly killed in an automobile accident and then condemned by the doctors to life-long paralysis. The presentation was slightly gruesome, but the automobile accident was a classic of the microphone. One heard the crash, the breaking of glass, the crunching of metal, the overturning of the machines, the screaming of the crowds, the ambulance, and finally the operating room.

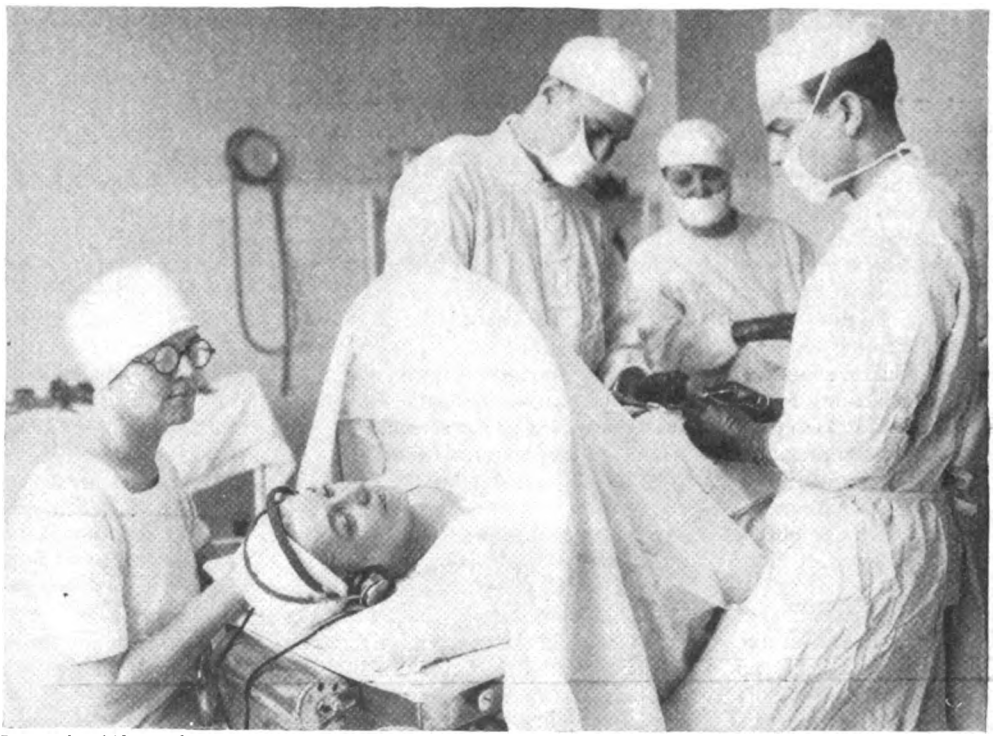
How was that all done? At the right moment, two pieces of metal were struck and then a plate of glass was hit and a little noise maker was slowly turned and the mob was set loose. The "mob" was four people, who, properly timed, gave the effect of many more. (And, speaking of crowds, a few people properly placed before the microphone are infinitely better than a real mob; in singing, also, it is better to have a dozen voices than a whole chorus set without regard to the microphone.)

In connection with the Sol Rothchild drama (with the principal actor carried to the studio on a stretcher to play his story in person) an ambulance bell was used; the operating room was suggested by the sound of instruments and the tearing of the bandages.

When "The Phantom Ship," a sailing vessel of many years ago, was broadcast as a play, one heard the conversation at the wharfs. The anchor was drawn up, the ship set sail, she rode the waves, encountered a storm, weathered it, came to calm, met a pirate ship, conquered and sailed back to port. The creak of the hull was simulated by a man moving back and forth in a creaky swivel chair. The window shades were rattled to represent the sails in the wind. A board was run over sandpaper to represent the swish of the waves. The ropes soughed and went up over pulleys; chains rattled; the captain and mate roared their orders. And when calm succeeded, the crew sang their chanteys.

One could list many novelty ideas in broadcasting sounds. In an indoor football game, for example, the audience listened to the sounds made by the players by placing the microphone in their midst during the scrimmages. The sounds of a circus—of the animals, the birds and the freaks—have been broadcast; so have the sounds of riveting, of sawing, of hammering, been broadcast from the top of an unfinished building in New York. Once some real atmosphere was created to put across a ghost story, by having it told actually to a group of youngsters who didn't know the microphone was open. And a scratching right on the microphone cage once gave the effect of a man trying to escape from a cell.

The dramatist of the future will make his plays with a definite conception of the limitations and opportunities of the microphone, and with an ability to translate "soundings" into "seeings."



International Newsreel

A NEW APPLICATION OF ETHER WAVES

Headphones that bring radio entertainment to the patient while he or she is undergoing an operation performed under spinal anæsthesia or local anæsthetics are the latest addition to the up-to-date operating room. Surgeons have found that music reduces the psychic shock of the operation and diverts the patient's mind. At St. Marks Hospital in New York City (where the above picture was taken) headphones were recently successfully used to minimize the shock to the patient.

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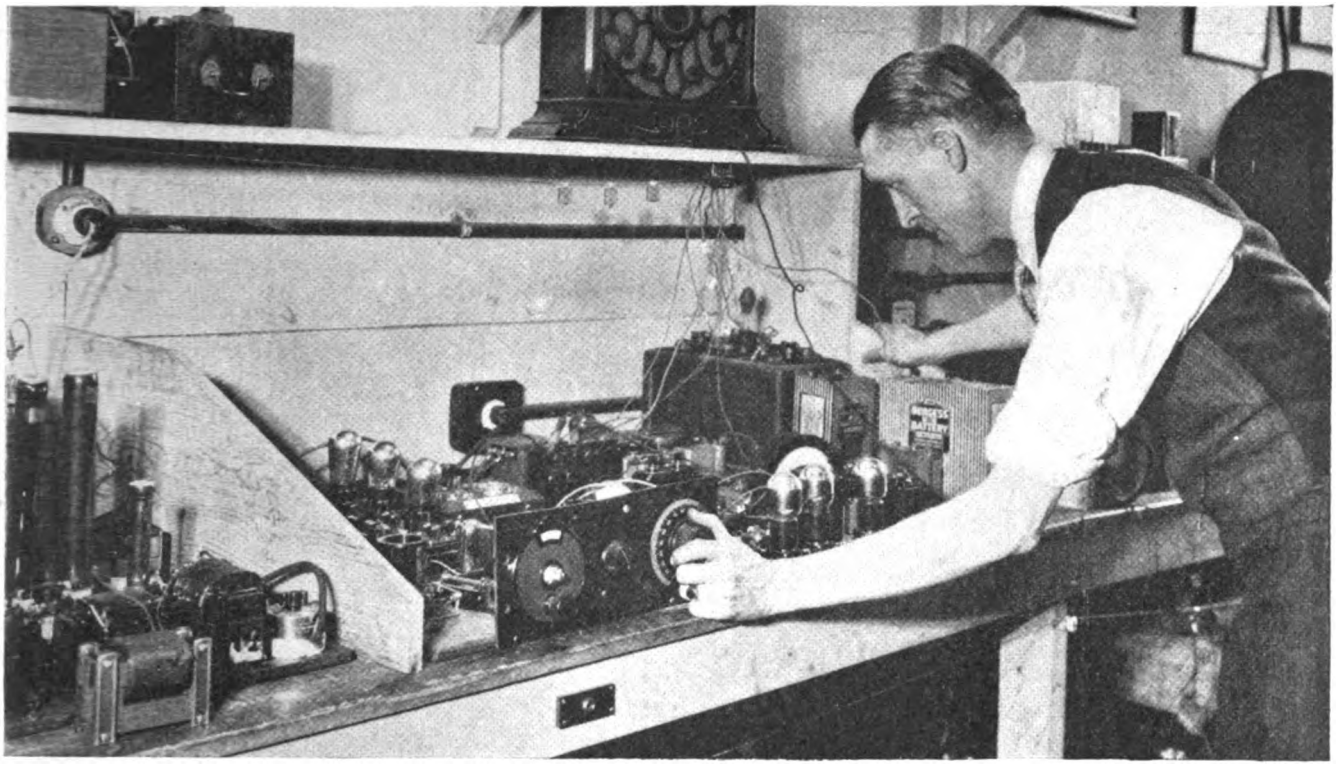

From a photograph made for POPULAR RADIO

TESTING RESISTANCE-COUPLED AMPLIFIERS IN THE LABORATORY

When resistance or impedance-coupled amplifiers are used in connection with certain types of "B" power-packs the parasitic oscillation at low frequencies known as "motor-boating" occurs and spoils the reproduction.

Resistance-coupled Amplifiers

How to Make Them Work With Power-packs

Squeals, "motor-boating" and "blocking" often spoil reproduction when this type of amplifier is used with a "B" power-pack; this article tells what causes this trouble—*and how to get rid of it.*

By WILLIAM T. TABER

EVER since "B" eliminators came into general use trouble has been experienced when they have been used in connection with resistance-coupled sets. This has been due to no inherent fault in the amplifiers or the power-packs but in the characteristics that arise when the two are coupled together.

A properly designed resistance-coupled amplifier will amplify the whole frequency band (as used in broadcasting). But it will also amplify the low-frequency hum from the AC power line so that a superimposed audio-frequency component, caused by regeneration due to the filter and the potential-dividing resistor network, may result.

In order to find out at exactly what frequency the trouble started, the writer, and his associate, Mr. J. G. Uzmann made many oscillograph pictures showing the electrical wave before entering the amplifier and after leaving the several stages. The slightest distortion would be shown clearly in these photographs.

In working on this problem Mr. Uzmann and his engineering associates first segregated the four main symptoms of trouble; these may be described as follows:

1. The generation of a low-pitched fluttering sound;
2. The production of a high-pitched "squeal";
3. A slow "clucking" noise;
4. Complete blocking of the audio-frequency amplifier.

In general, all of the "B" power-packs now on the market, when used with resistance-coupled amplifiers, give these types of trouble.

This is due to the following causes:

1. Low-frequency regeneration, caused by the "B" potential-dividing resistor network;
2. Relatively poor action from the filter circuits because of insufficient capacity or inductance or both in the filter network;
3. High-resistance filters;
4. Variable AC line voltages, or power surges;
5. Poor voltage control of rectified currents;
6. Occasional failure or irregular operation of the rectifier device;
7. Unstable variable resistances for "B" voltage adjustment;
8. Amplification of the unfiltered "ripple."

It has been found that these difficulties may be eliminated simply by changing a few resistance values in the low-frequency amplifier.

Resistance-coupled, low-frequency am-

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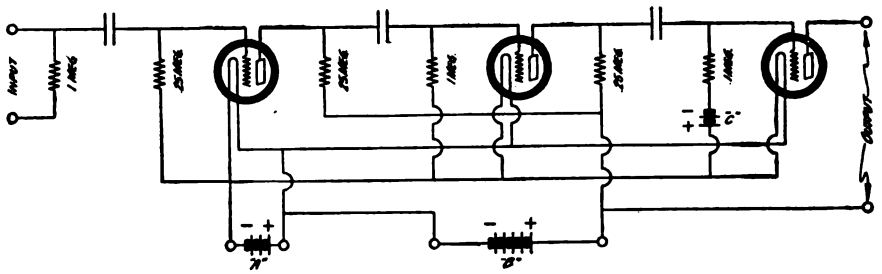

FIGURE 1: *This diagram shows, schematically, the hook-up for a standard resistance-coupled amplifier.*

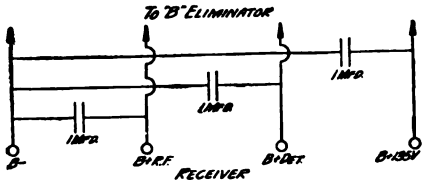

FIGURE 2: *The addition of by-pass condensers across the various plate supplies to the intermediate stages will often eliminate regenerative troubles.*

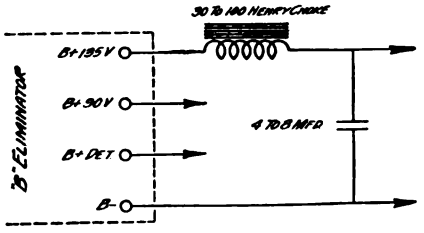

FIGURE 3: *A choke coil in the high-voltage lead shunted by a large fixed condenser is sometimes sufficient.*

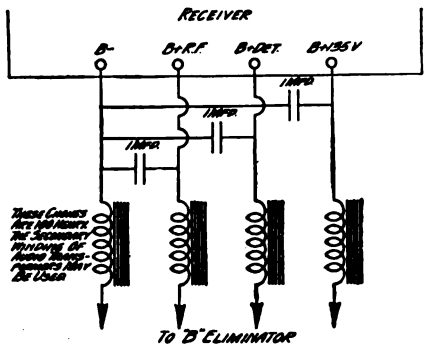

FIGURE 4: *A combination of the schemes shown in Figures 2 and 3 may clear up the trouble if both fail separately.*

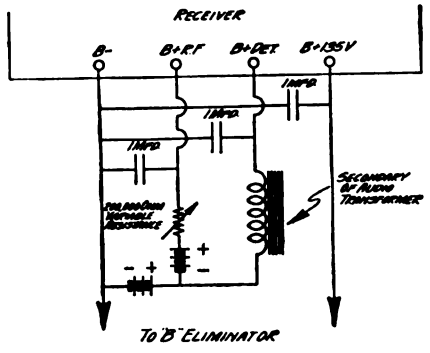

FIGURE 5: *The variable resistance may be adjusted until the unwanted frequency beat stops.*

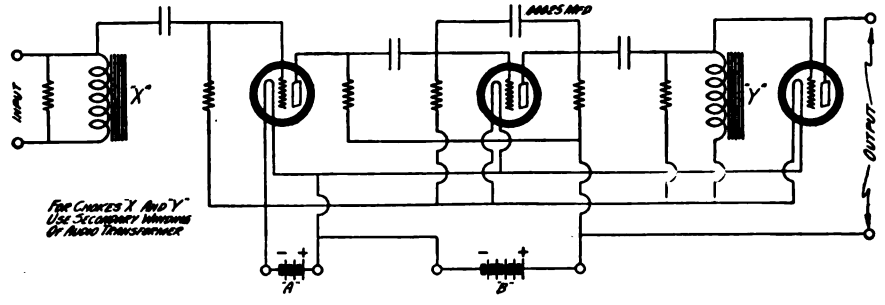

FIGURE 6: *The use of two chokes, X and Y, with a .00025 mfd. condenser, as shown, often succeeds.*

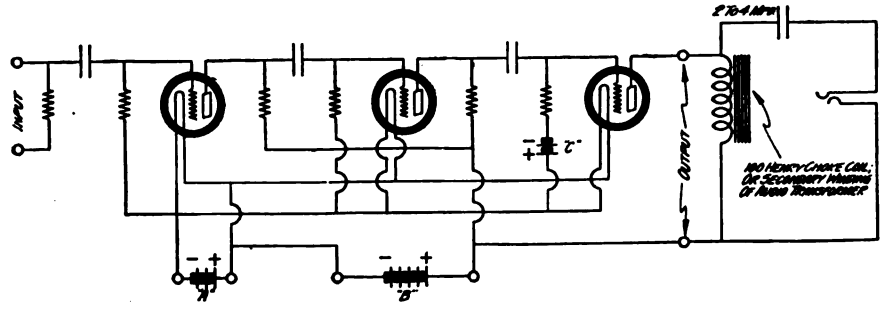

FIGURE 7: *An output filter and proper "C" bias may eliminate trouble.*

plifiers have heretofore used the following values for the coupling resistances:

The first-stage, plate resistor—$^1/_{10}$ meg.;
The first-stage, grid resistor—1 meg.;
Second-stage, plate resistor—$^1/_{10}$ meg.;
Second-stage, grid resistor—$^1/_2$ meg.;
Third-stage, plate resistor—$^1/_{10}$ meg.;
Third-stage, grid resistor—$^1/_4$ meg.;

These values have become accepted as standard; and you will most likely find that the ones in your resistance-coupled low-frequency amplifier correspond with them in resistance values.

Figure 1 shows the substitutions which should be made when the amplifier is to be used with a "B" power-pack.

Change the first-stage, plate resistor from $^1/_{10}$ meg. to ½ or 1 meg.;
Change the first-stage, grid resistor from 1 meg. to ¼ meg.;
Change the second-stage, plate resistor from $^1/_{10}$ meg. to ¼ meg.;
Change the second-stage, grid resistor from ½ meg. to $^1/_{10}$ meg.;
Change the third-stage, plate resistor from $^1/_{10}$ meg. to ¼ meg.;
Change the third-stage, grid resistor from ¼ meg. to $^1/_{10}$ meg.

Sometimes a high-mu tube may still show a slight tendency to produce the familiar symptoms even after these changes have been made but generally the first stage only is affected.

If you have this experience, either change the tube positions or replace the first high-mu tube with a UX-201-a type tube. The remaining recommendations are not ordinarily necessary unless the "B" power-pack filter is improperly designed.

Figure 2 shows the addition of a number of 1 mfd. condensers. These are placed so that the "B" power-terminal connections at the receiver will be bypassed. Always ground the "B" minus (—) terminal.

Sometimes it is necessary to improve the characteristics of the filter. This can be readily accomplished by increasing the values of the condensers or chokes, as shown in Figure 3.

Figure 4 shows a sketch of an audio amplifier with several recommendations for better operation. Sometimes all three of these must be used before complete elimination of the trouble is experienced. They are:

1. Use .25 or .1 megohm grid-leaks for the third and possibly the second stage;

2. Shunt the audio-transformer secondary winding across the plate resistors of any stage; the first stage is usually best.

(*Continued on page 393*)

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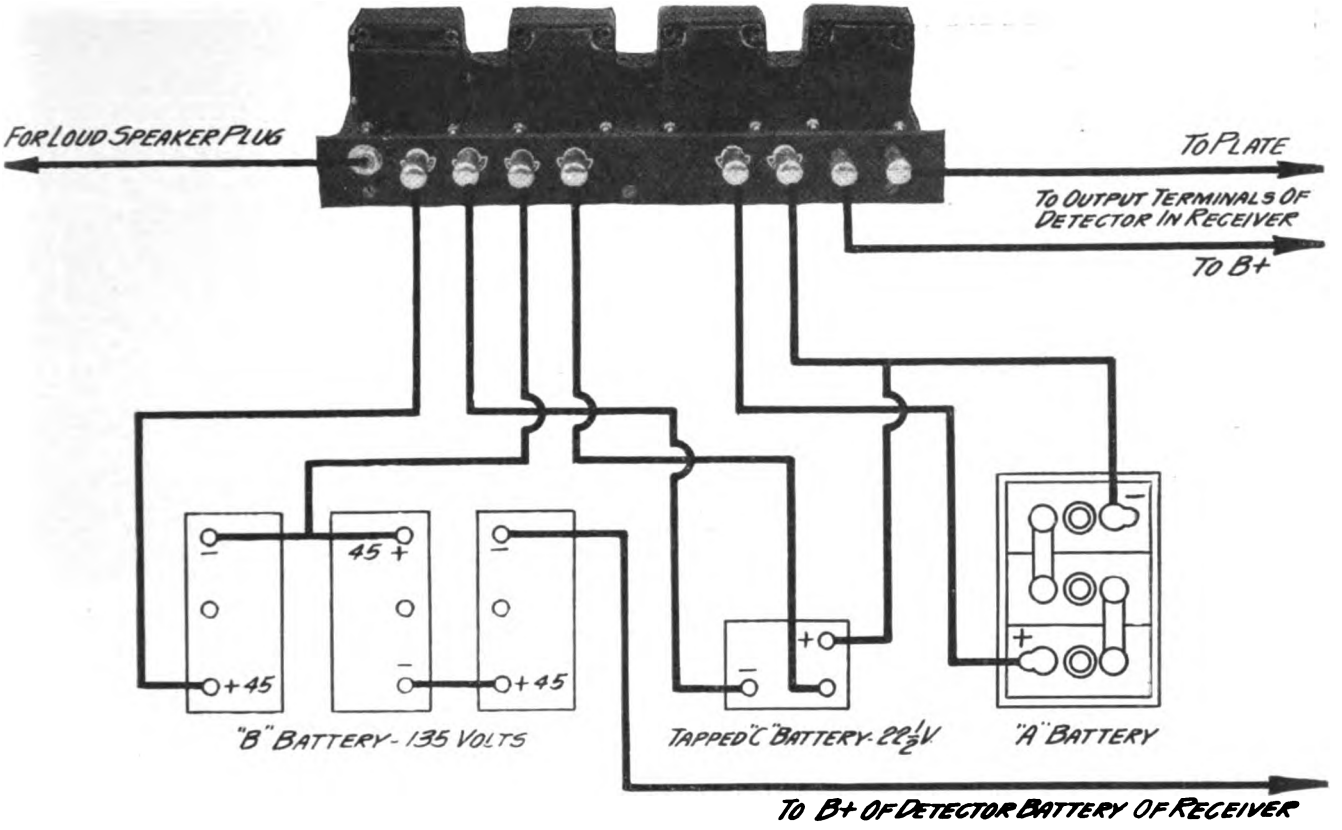

HOW TO HOOK UP THE AMPLIFIER

FIGURE 1: *The proper connections for the batteries and for the input and the output of the Truphonic system are shown here; notice that the negative end of the "B" batteries is connected to the detector tap on the receiver.*

How to Get Quality Amplification

NUMBER 2: *How to Build a Low-Frequency Amplifier Using the Truphonic Coupling Units*

This new series of constructional articles describes in detail the modern methods of amplification at low frequencies for obtaining quality reproduction. The amplifier units are small, compact and easy to build and they may be inserted either in an old receiver or in a new one to obtain undistorted amplification.

By THE TECHNICAL STAFF

COST OF PARTS: *Not more than $29.00*

HERE ARE THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS UNIT—

A, B and C—Na-ald Truphonic low-frequency couplers, No. 301;
D—Na-ald output filter unit (choke and condenser), No. 300;
E—Any approved automatic filament control for 1 ampere (Brachstat control illustrated);
F1, F2 and F3—Any approved UX type vibrationless sockets (Benjamin sockets illustrated);
G—Tobe output condenser, 4 mfds., working voltage 250 volts DC;
H—Any approved small single-circuit jack (Carter jack illustrated);
I1, I2, I3, I4, I5, I6, I7 and I8—Any approved binding posts (X-L binding posts illustrated);
J—Hardwood baseboard, 6 by 12 by ½ inch;
K—Composition binding-post strip, 1½ by 12 by 3/16 inch.

HERE is a new amplifier embodying a new idea in inter-stage coupling unit design, that gives exceptionally true and natural reproduction. It is easy to assemble and consists of three stages of Truphonic-coupled amplification with an output filter for keeping the DC potential of the power tube from the windings of the reproducer, thus protecting them from possible injury.

This amplifier may be incorporated in place of the old-fashioned amplifier unit in an old receiver to bring the quality of reproduction up-to-date, or it may be used with a new model that the experimenter proposes to build in his home.

The model described was designed especially for this purpose by the staff of POPULAR RADIO EXPERIMENTAL LABORATORY and the tests show that it is exceptionally good.

The schematic wiring diagram for the unit is shown in Figure 2.

(*Continued on page 394*)

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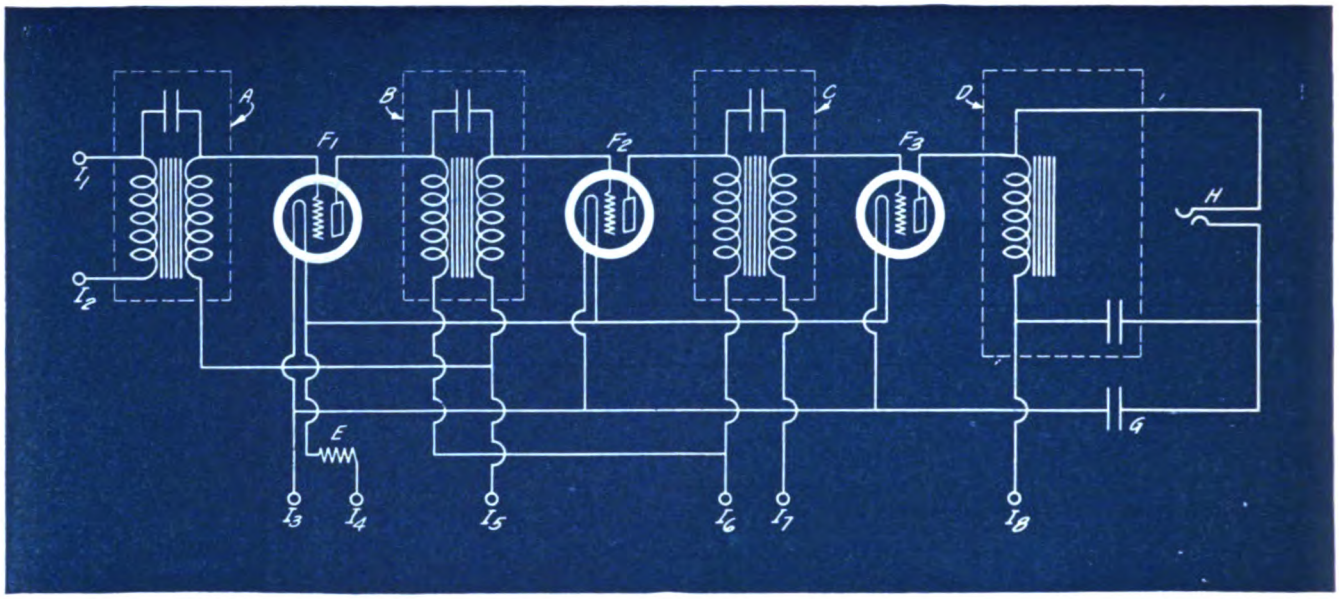
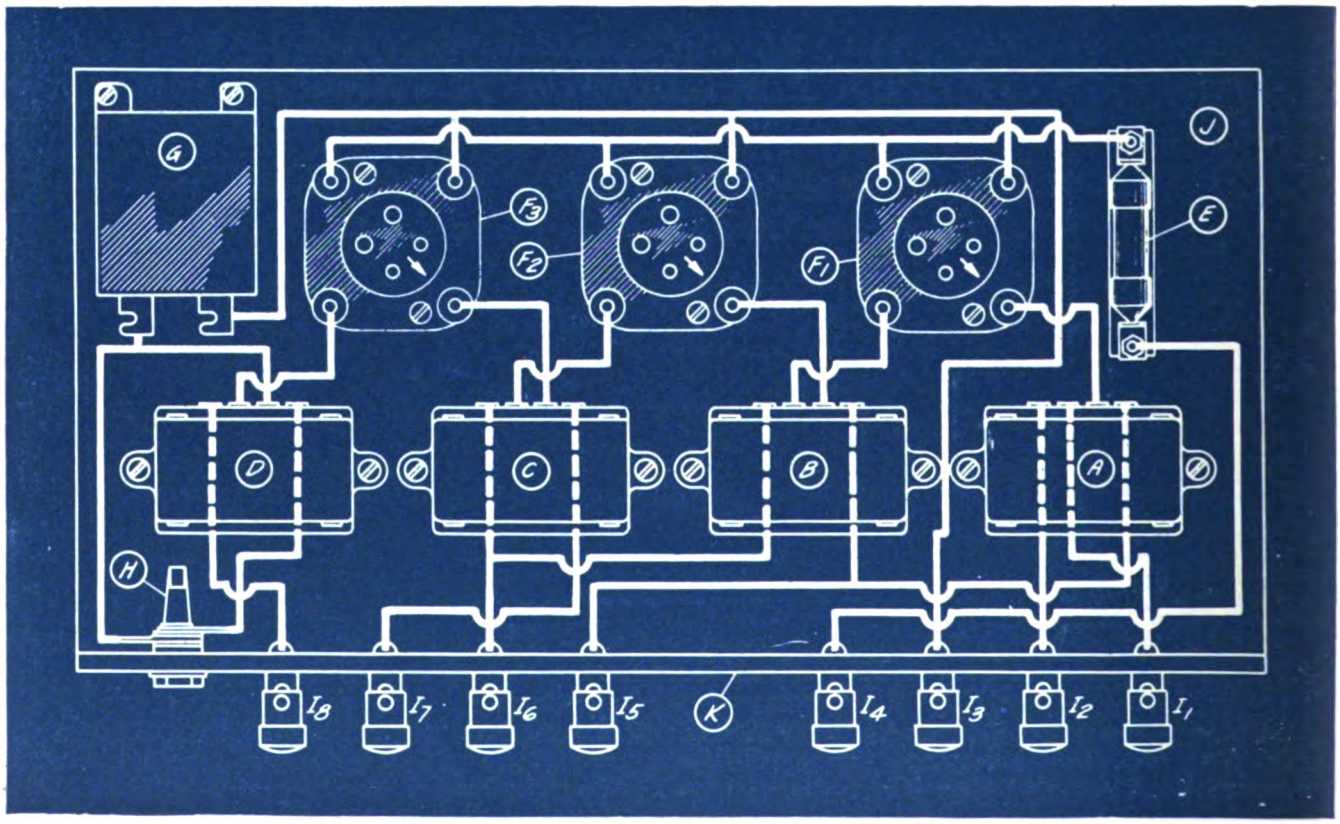


THE SCHEMATIC WIRING DIAGRAM

FIGURE 2: *The exact scheme of connections of the three Truphonic coupling units, A, B and C, and the output filter device, D, are given in this diagram. A second by-pass condenser, G, has been added to forestall the possibility of coupling in the output stage.*

¶ *The list of parts given on page 341 includes the exact instruments used in the laboratory model of this receiver. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*



THE PICTURE WIRING DIAGRAM

FIGURE 3: *This drawing, which will help the builder to lay out the instruments in their correct, relative positions, also gives in heavy white lines the exact electrical connections to every part used in the receiver.*

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HELPS FOR CUTTING DOWN MAN-MADE

Interference

Don't blame all radio interference on static and station interference; much of it may be due to machinery in your own home. This article tells how to trace down this troublesome type of interference and reduce it.

By LAURENCE M. COCKADAY

TO the man in the street there is only one kind of radio interference —static.

All of the troublesome noises that interfere with his radio reception he groups under this convenient name. And he takes them with a grumble like the weather—bothersome but unescapable.

But the expert knows that these noises may come from a great many different sources; he knows that much of the so-called "static" may be traced down and eliminated. So, for convenience, he divides the various kinds of radio interference into five general classes:

1. Static proper;
2. Interference between stations on adjoining wavelengths;
3. Interference from radiating receivers;
4. Code interference from badly-tuned spark transmitters;
5. Inductive interference from electrical machinery.

The first of these five divisions, static proper, is due to electrical disturbances in the atmosphere and is somewhat tied up with weather conditions. This trouble is rapidly being reduced by the increased power of modern broadcasting stations, which is placing the signals on a basis of greater strength than the static. This particular form of static is less of a troublesome feature than it used to be.

The second source, interference between stations may be—and will be—reduced by greater selectivity in modern receiver design and by a better zoning and allocation of transmitting stations.

The third interfering factor, the use of radiating receivers, is being brought more and more under a voluntary ban by the broadcast listeners themselves; this type of interference is perceptibly lessening.

Code interference from broadly tuned spark transmitters (the fourth class) is also gradually being done away with, as both the commercial and Navy code transmitters are gradually being converted into continuous-wave, vacuum-valve apparatus that is capable of being tuned as sharply as the broadcasting apparatus itself.

The fifth kind of interference, however (inductive interference from electrical machinery), is causing more and more trouble as the antennas used for reception become smaller and smaller and sets become more sensitive. The more sensitive a receiver is, the more inductive interference it will pick up; and although this kind of interference is reduced by the use of modern shielding in the receiver, this does not, in itself, serve as a final remedy.

Under this latter type of interference may be classed interference from motors, elevators, oil burners, refrigerators, washing machines, high-frequency vibrators, violet-ray machines, rotary converters and dynamos in sub-stations, trolley cars, small DC and AC universal motors, electric signs, power transmission lines and many other electrical devices and appliances used in commerce or in the home.

The man-made static from these devices is generated at the point of contact of rotary switches—at the vibrators of high-frequency apparatus, at dirty commutators of motors or generators and through the leaks in power transformers or in transmission lines.

The small or large sparks set up by these leakage currents or contact arcs generate exactly the same kind of radio waves as set up by the old-fashioned spark transmitters. However, the electrical surges generated by these sparks, travel along the power lines, to which the apparatus is connected, and are thus easily picked up by receivers located near them.

This effect is more especially true in receivers that operate without batteries from associated power lines. The waves are usually picked up by the antennas of receivers from the power lines and produce crackling sounds, buzzes, hums and other raucous noises too numerous to mention.

The best way to cut out this trouble is to stop it at its source, to catch it before it gets into the power lines. This, fortunately, is really easy to do.

From a photograph made for POPULAR RADIO

HOW TO REDUCE INTERFERENCE FROM YOUR ELECTRIC MOTOR

FIGURE 1: *A simple way to cut down trouble from this source is to insert a filter between the motor and the power lines. Filters like the one shown above are now made expressly for this purpose; they may be easily connected in circuit by any fan.*

The power companies are always willing to cooperate with the radio users in checking up leaks in their lines and repairing them.

But the job in the home has been given little consideration, although it is easy to remedy. To stop the disturbances from motors and generators, an examination of the commutators should first be made. They should be cleaned with fine sandpaper and the brushes should be adjusted so that sparking will be reduced to a minimum. The same holds true for switches and other electrical contacting devices of this nature. This will not be a positive cure but it will reduce the trouble.

A further step, that will positively eliminate the trouble, is to interpose iron-core chokes of the proper inductance and of large enough wiring to pass the load-current. These should be connected as close to the apparatus as possible and should be designed to allow the free passage of the direct or alternating current for running the motor or other device. But these chokes should stop the high-frequency disturbances, generated at the contactor on the device, from passing back to the power lines. These

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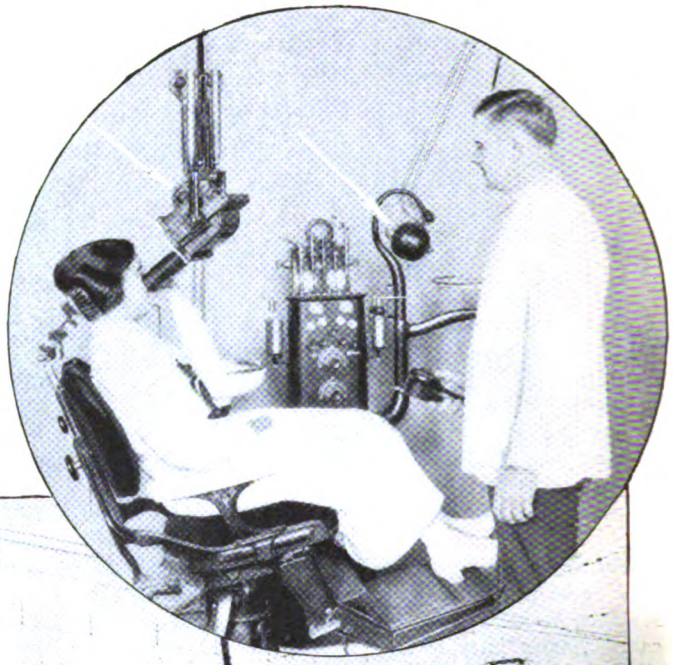
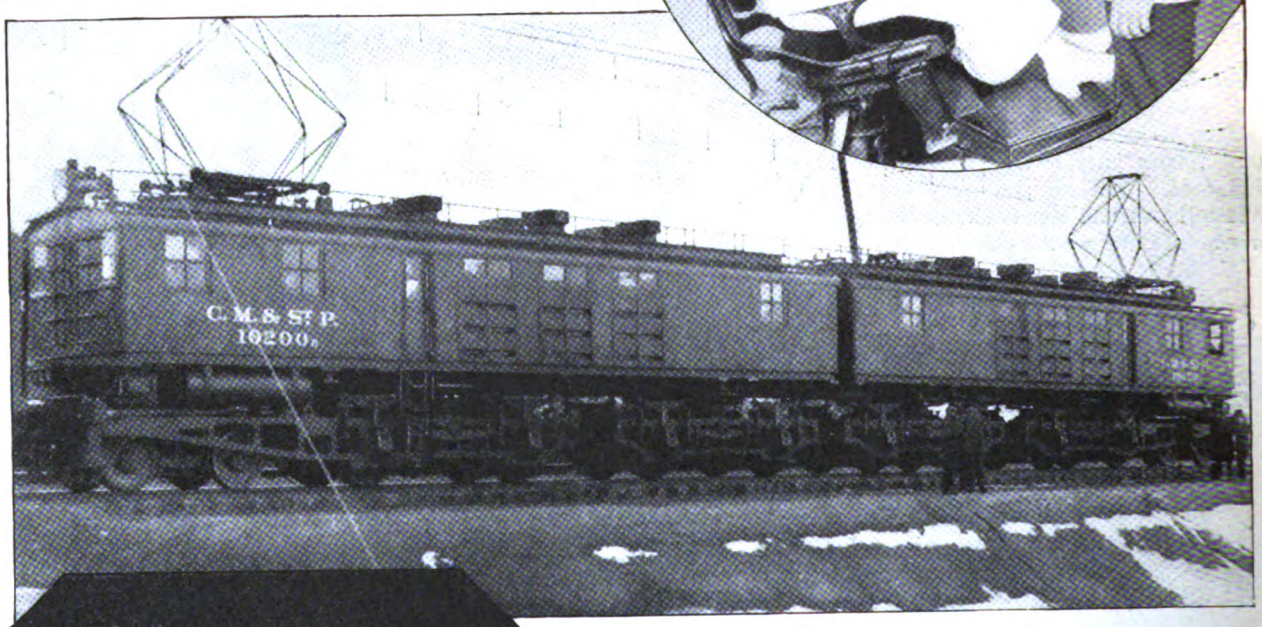
5 Sources *of* Interference

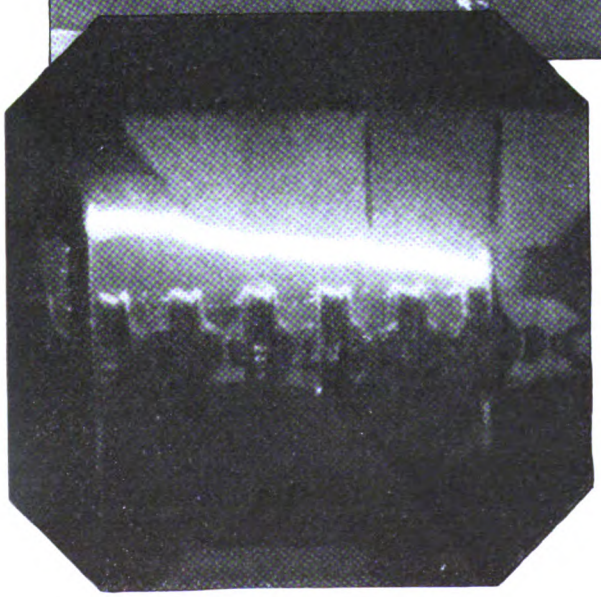
Brown Bros.

1: Old-type X-Ray apparatus used by doctors and dentists may broadcast interference to receiving sets within two city blocks.



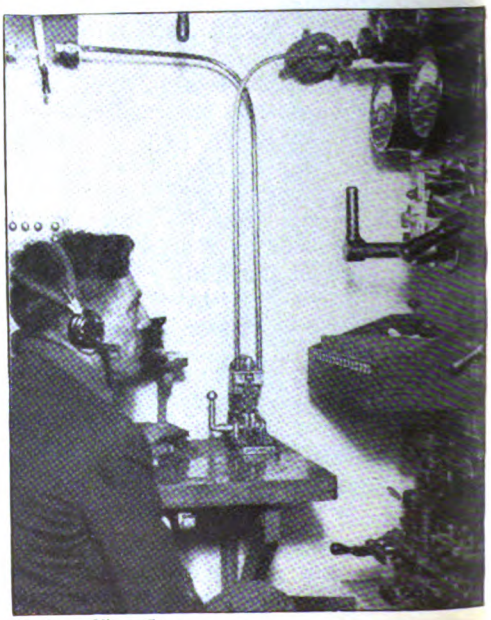
2: Dirty commutators on electric motors are a common source of interference.





4: The high-tension apparatus used in testing laboratories may act as a transmitter of interference to receivers.

3: Sparks jumping from the trolleys of nearby electric trains will cause noises in your loudspeaker.



5: The old-time spark transmitters used on ships will cause widespread interference.

Keystone View Co.

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high-frequency disturbances should then be by-passed to the ground. This may be done easily through the use of fixed condensers of reasonably large size which will interpose between the chokes and the brushes or contactors of the motor, or other device.

Two condensers may be placed in series across the brushes and the center point may be connected to a good ground. A further precaution on a sparking commutator is the use of a resistance in series with the condensers to reduce the pitting effect of the intensified sparks at the commutator.

Here is an outline of a simple piece of apparatus that will cure almost any case of man-made interference of this kind. If the interference is exceptionally bad, the chokes and condensers must necessarily be larger than for the average case; the only absolute necessity is a wire large enough to carry the current used by the device which is causing the trouble.

Usually an iron core of a square inch in cross section, wound with 100 turns of insulated wire of the proper size, will be suitable for the electrical appliances used in the home. A layer of empire cloth should be wrapped around the core before winding and a closed core should be used in all cases. The best range of condensers is from 1 to 4 mfds. each and the resistances in series with them will usually be from 2 to 4 ohms.

This device is known as a filter and should be connected into the line between the motor and the source of power.

In applying a device of this kind to electrical machinery of any description, the important point to remember is that all leads between the filter and the actual point of the disturbance (as in a violet-ray tube), must be shielded and the shield must be grounded.

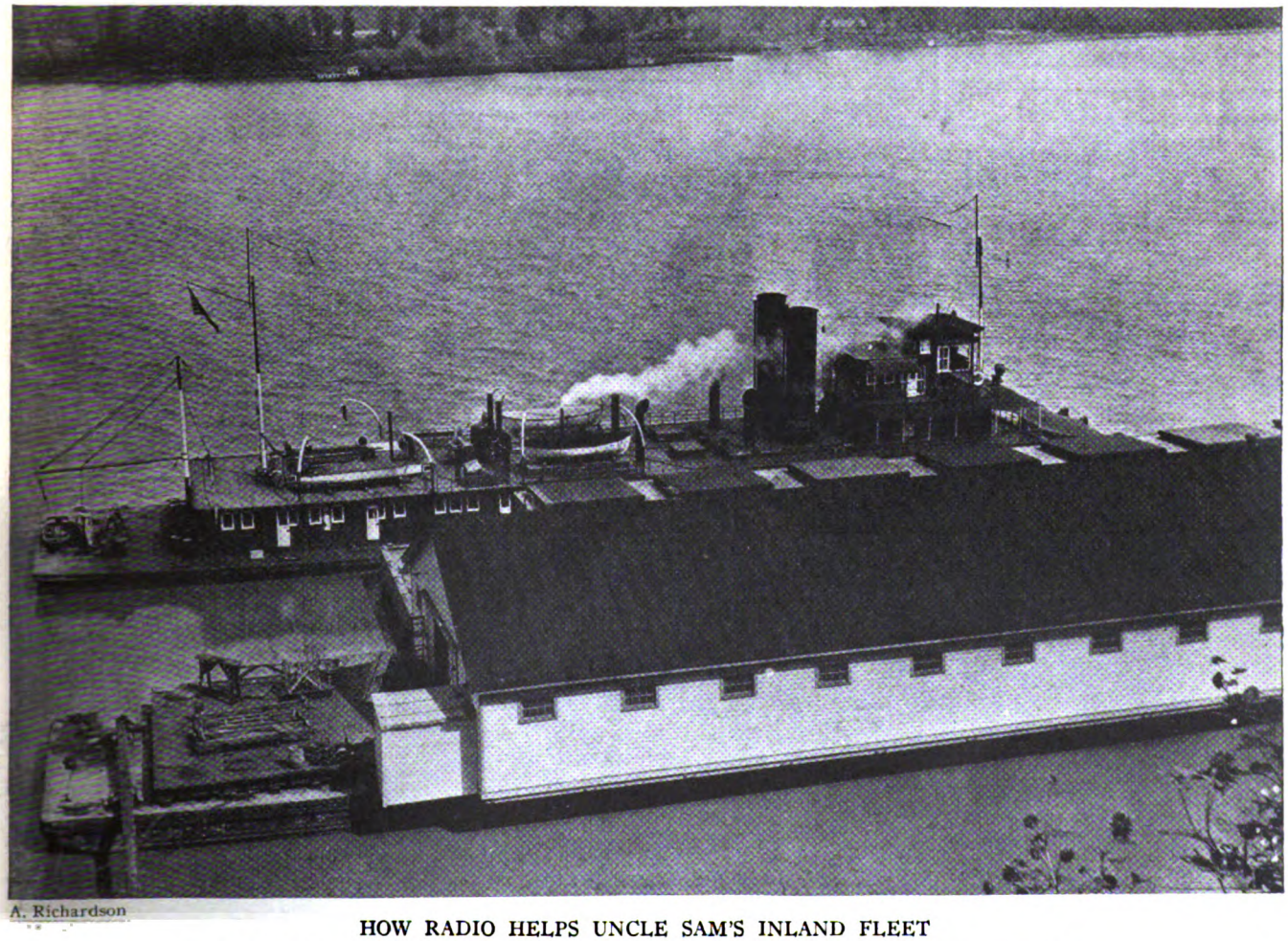
In apparatus that employs very high frequencies, such as the X-ray equipment used by doctors and dentists, this shielding is not always so easy; as a rule a metal cabinet is employed and the X-ray valve itself is covered with lead, except at the window.

Any work around high-frequency or high-voltage machinery should be carefully done and only after consulting with some one who understands it thoroughly.

With large electrical machinery, such as electrical motor generators in substations, exactly the same tactics may be employed; but this work is usually carried on, as a matter of protection, by the public utility companies themselves.

The hum picked up from the AC lines is usually greatly reduced through suitable grounding. In the case of amplifiers or "B" power-packs, grounding of the cases of the instruments will help.

Simple and inexpensive devices, such as that pictured in Figure 1, are now obtainable at any radio store, for taking care of "man-made" interference from appliances which operate on powers up to and including ¼ HP. These appliances may be easily connected in circuit, and when used will reduce such interference for the set user.



A. Richardson

HOW RADIO HELPS UNCLE SAM'S INLAND FLEET

Uncle Sam's fleet of barges was almost driven off the Mississippi River by railway competition—until radio appeared on the scene. Now the radio system on the government fleet, including a central 5-KW station at Memphis (WPI), Tenn., a 2-KW station on each towboat and a 1-KW station on each express boat (one of which is shown above), makes it possible for shippers to keep in touch with the progress of their goods down the river, to forecast the exact time when they will arrive and to provide the labor at the docks without wastage.

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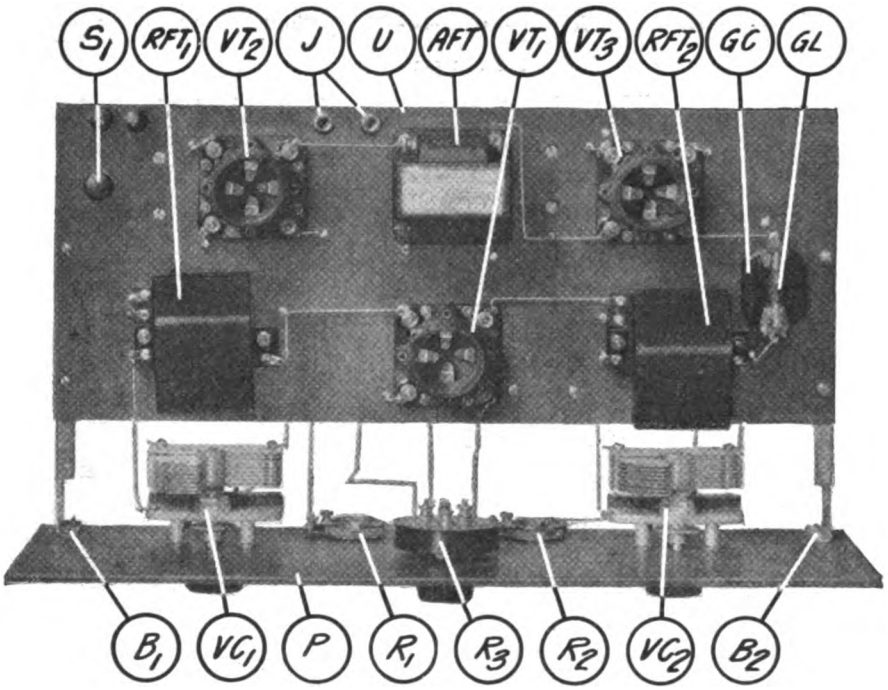


The "De Luxe Cle-Ra-Tone" Receiver

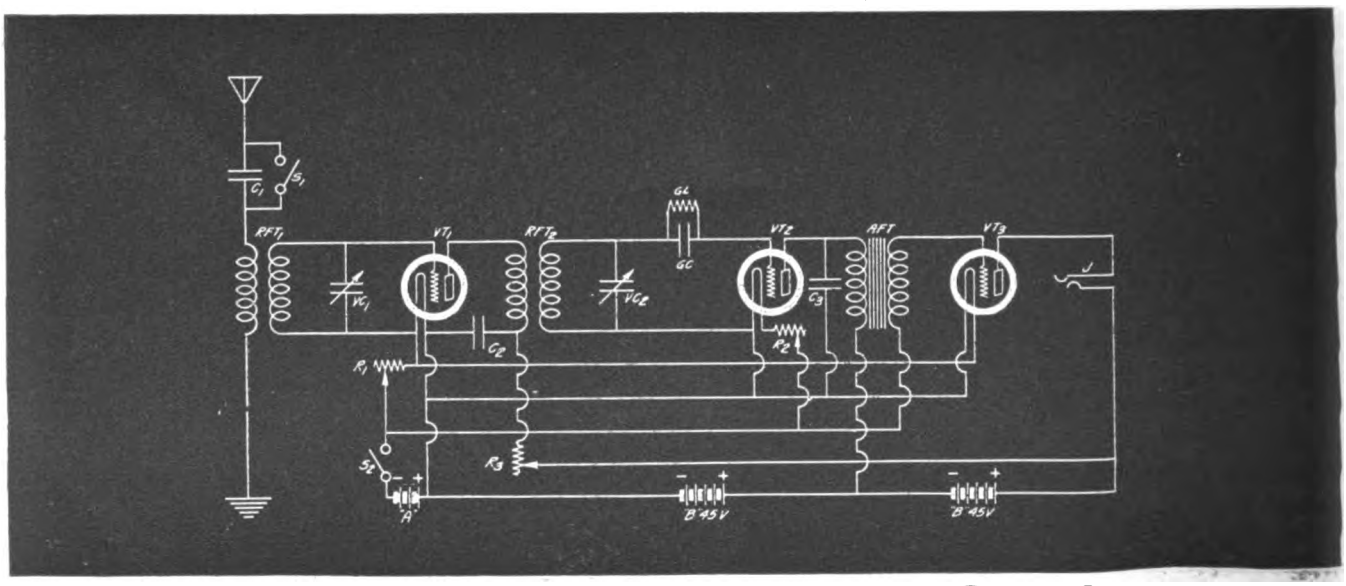
This receiver, while it employs only three vacuum valves, has remarkable possibilities. It employs a single-stage, high-frequency amplifier of excellent selectivity, a vacuum valve detector and one stage of high-grade, transformer-coupled, low-frequency amplification. The set may be readily combined with a complete power amplifier such as the Pacent power amplifier without any changes in the circuit.

Popular Radio Circuits

INSTALLMENT NO. 9

THE PARTS THAT ARE RECOMMENDED FOR USE IN THIS RECEIVER ARE—

RFT1 and RFT2—Benjamin tuned-high-frequency transformers, No. 8621;
AFT—Rauland-Lyric low-frequency transformer, type R-500;
VC1 and VC2—Benjamin variable condensers, .00035 mfd., No. 8661;
VT1, VT2 and VT3—Benjamin sockets, No. 8645, or No. 9040;
R1—Carter midget rheostat, 10 ohms;
R2—Carter midget rheostat, 25 ohms;
R3—Centralab Radiohm, 200,000 ohms;
B1 and B2—Benjamin shelf-supporting brackets, No. 8629;
GC—Sangamo fixed condenser, .00025 mfd., with grid-leak mounting clips;
GL—Daven grid resistor, 2 meg.;
C1—Sangamo fixed condenser, .00025 mfd.;
C2—Dubilier by-pass condenser, .5 mfd., type 656;
C3—Sangamo fixed condenser, .002 mfd.;
J—Two Carter Imp tip jacks;
S1 and S2—Benjamin switches, No. 8640;
P—Composition panel, 7 by 18 by 3/16 inch;
U—Composition sub-panel, 7 by 17 by 3/16 inch;
Jones Cablelug battery connector;
2 Apex satin-silver CCW vernier dials;
2 Eby "Ensign" engraved binding posts, marked "Ant" and "Gnd";
Cabinet for 7 by 18-inch panel, depth, 10 inches.
COST OF PARTS: $45.00.



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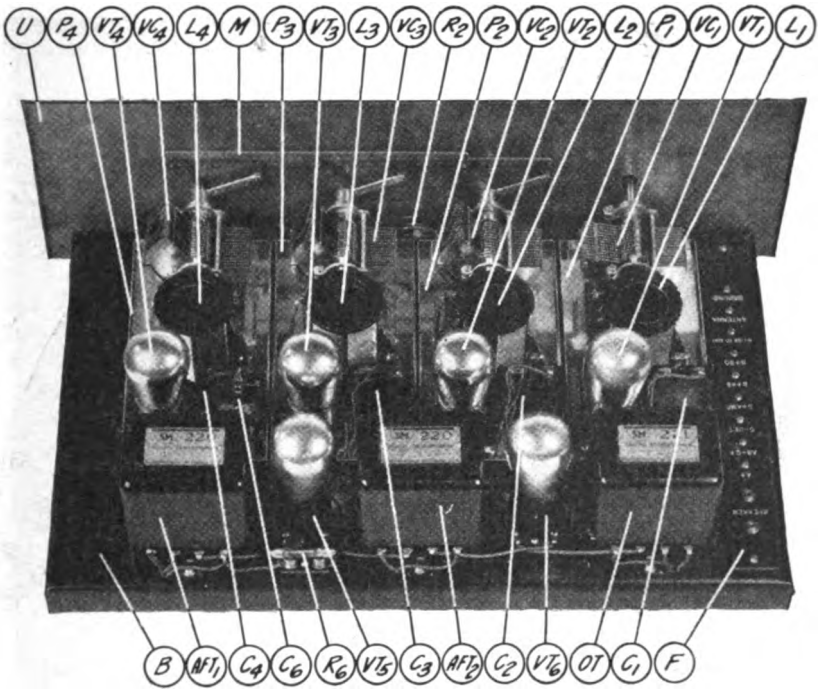
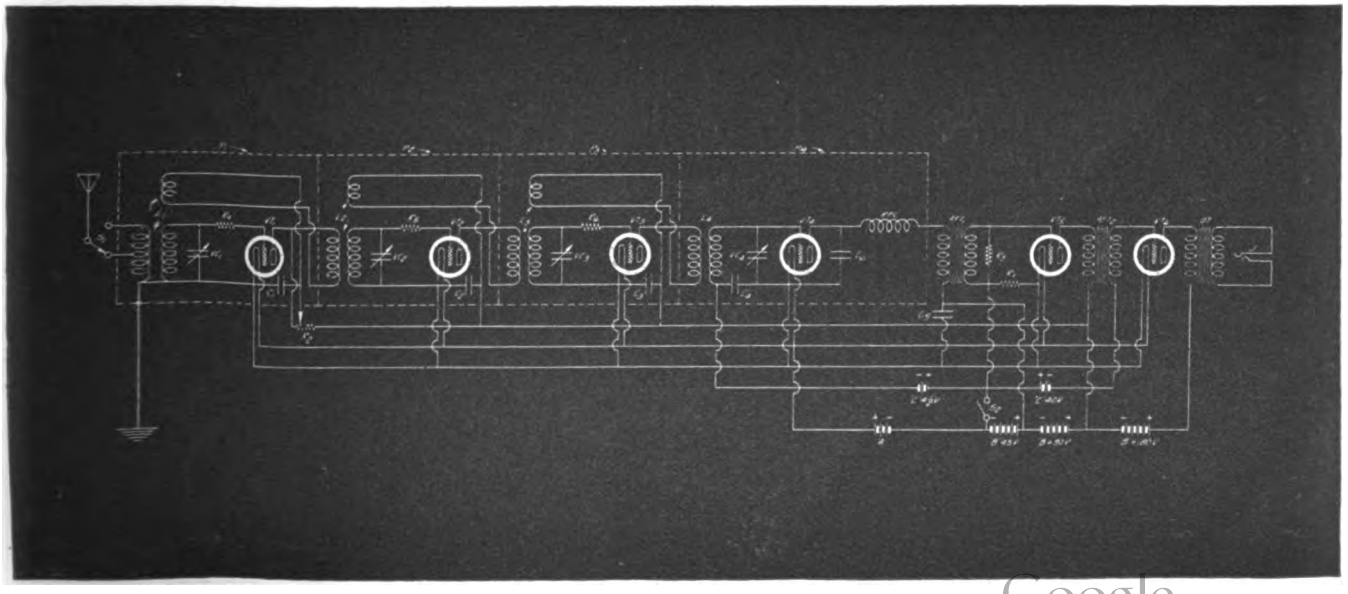


The Silver "Shielded Six" Receiver

This six-tube receiver incorporates balancing coils in its high-frequency amplifier; they are designed to reverse the feedback to the succeeding grid circuits of the tubes for stabilization. With three stages of high-frequency amplification, one detector and two stages of high-grade, transformer-coupled, low-frequency amplification, distance reception should be obtained with exceptional volume and clarity, especially when the output is coupled with a cone-type reproducer. A UX-171 type of tube is recommended for the last stage of amplification.

The Parts that Are Recommended for Use in this Receiver Are—

L1—Silver-Marshal antenna-coupling coil, type 116A;
L2, L3 and L4—Silver-Marshall high-frequency coils, type 115A;
VT1, VT2, VT3, VT4, VT5 and VT6—Silver-Marshall sockets, type 511;
S1—Yaxley "Midget" antenna switch;
S2—Yaxley battery switch, No. 10;
C1, C2, C3, C4 and C5—Polymet by-pass condensers, 1 mfd.;
P1, P2, P3 and P4—Silver-Marshall shields, type 631;
VC1 and VC4—Silver-Marshall variable condensers, type 316B;
VC2 and VC3—Silver-Marshall variable condensers, type 316A;
R1—Carter fixed resistor, .5 ohm, No. H-½;
R2—Carter "Hi-Pot" volume control, 25,000 ohms;
R3—Polymet fixed resistor, .25 meg.;
R4, R5 and R6—Carter fixed resistors, No. H-200, 200 ohms;
AFT1 and AFT2—Silver-Marshall low-frequency transformers, type 220;
OT—Silver-Marshall output transformer, type 221;
J—Carter tip jacks (two), No. 10;
RFC—Silver-Marshall high-frequency choke coil, type 275;
C6—Polymet mica condenser, .002 mfd.,
M—Silver-Marshall triple-shaft-link motion, type 632;
U—Crowe metal panel, drilled and engraved;
B—Metal chassis, drilled;
F—Composition binding-post strip, with terminals;
2 Kurz-Kasch 100 four-inch dials, No. 567;
1 Polymet resistor mounting;
4 Silver-Marshall coil sockets, type 515.
Cost of Parts: $95.00.



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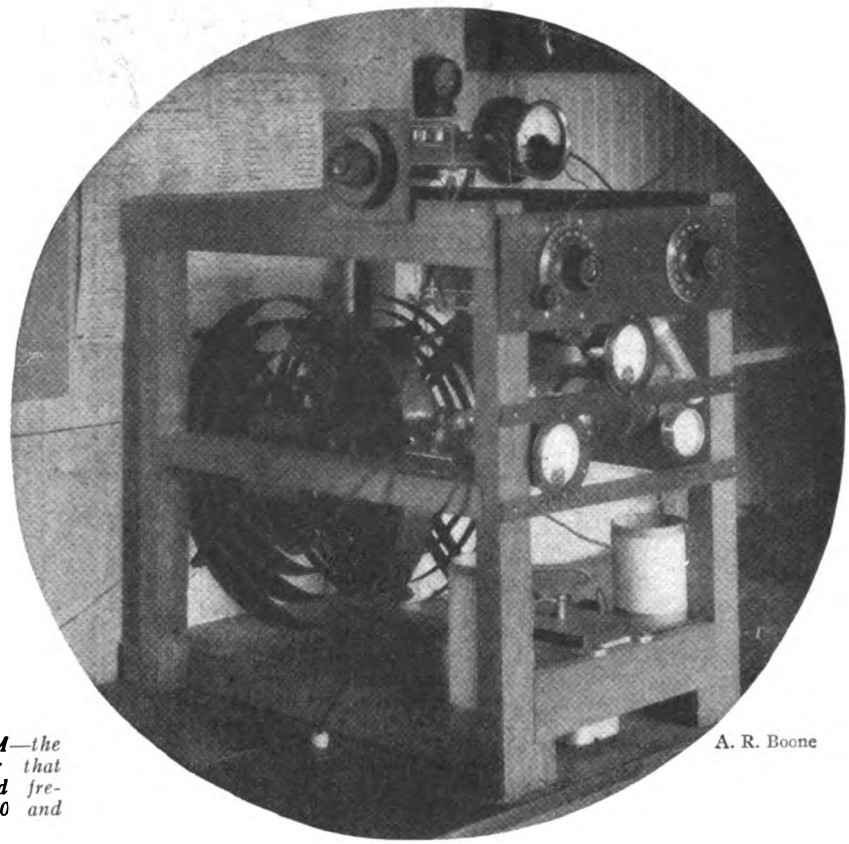
¶ Do you want to check up on your wavelength? Read what station 6XBM is doing to reduce interference by helping every broadcaster and amateur transmitter to keep on the proper wavelengths



The "heart" of 6XBM—the vacuum-tube oscillator that generates the standard frequencies between 1,500 and 6,000 kilocycles.

A. R. Boone

Uncle Sam's Wavemeter

By ANDREW R. BOONE

HOUSED in a small wooden building in the rear of a high-voltage laboratory at Stanford University, California, is the station by which the wavemeters of half America may be calibrated—the Pacific Coast Standard Frequency Station, 6XBM.

Day after day this station transmits signals on frequencies ranging from the short-wave amateur bands to the high commercial wavelengths; from these signals the wavemeters that help to keep stations on their proper frequencies may be kept accurate by "hams" and engineers alike.*

Although these standard frequencies are transmitted mainly for the benefit of transmitting stations, listeners may also use them to calibrate their receivers. By merely noting the points on the dials on which each standard frequency comes in, each listener may draw up an accurate chart that is invaluable in tuning in DX.

Extreme care is employed by 6XBM to keep the signals that are broadcast accurate to the last degree. Two transmitting sets on a master-oscillator power-amplifier system are used, one for lower frequencies (125 KC to 1500 KC, or 200 to 2,400 meters) and one for frequencies from 1,500 to 6,000 kilocycles. In the former, the master-oscillator is a UV-203, 50-watt tube and the power amplifier a UV-204, 250-watt tube; for higher frequencies a UV-204, 250-watt tube in a Hartley circuit is employed.

In operation the low-frequency set is tuned to an exact frequency. The master-oscillator inductor and the condensers are adjusted to produce approximately the desired frequency, the power output being kept low. With the capacity of the coupling condenser reduced, the antenna circuit is tuned to resonance with the master-oscillator frequency by adjusting for maximum antenna current and minimum plate current. Then, to secure maximum output, the capacity of the coupling condenser is increased and the plate tap of the antenna inductor is adjusted to bring the plate current to approximately normal value. Final adjustments are made by turning the master-oscillator to the exact frequency desired and tuning the antenna circuit to it. The final tuning of the master-oscillator is accomplished by use of the small variable condenser shunted across two of the primary tuned-circuit condensers.

In transmitting with the high-frequency set the antenna circuit is not tuned exactly to resonance. In tuning for a given frequency, the antenna circuit coupling is loosened and the antenna condenser set so the antenna is detuned. Adjustments are made to produce approximately the desired frequency with the plate current at a low value, with the maximum antenna current which will allow stable operation without exceeding the safe value of the plate current. Final adjustments are made by means of

* Station WWV at Washington, D. C., sends out standard frequency signals for the benefit of eastern transmitters. The schedules which these two stations maintain may be obtained in bulletin form from the Bureau of Standards at Washington, D. C.

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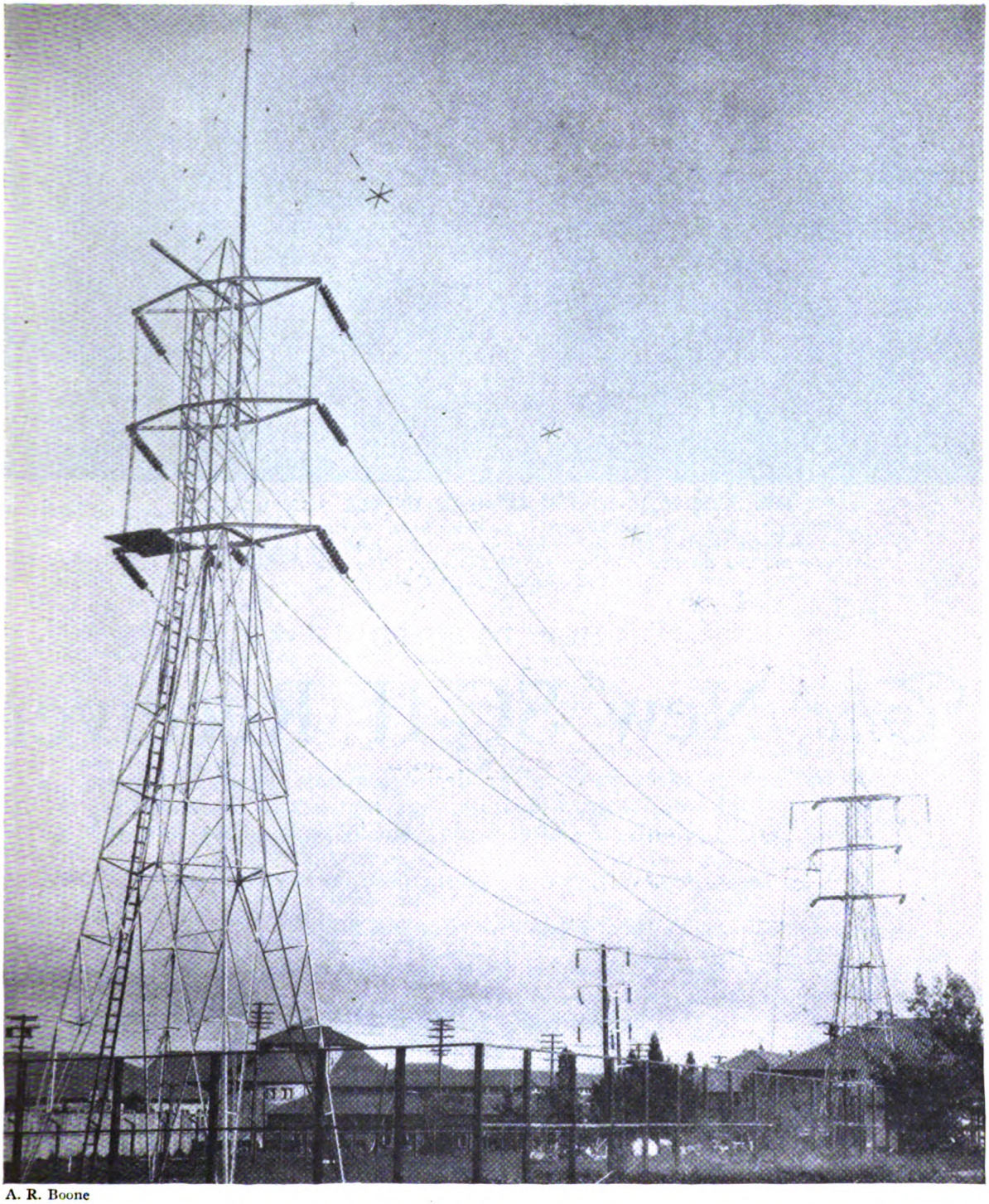

A. R. Boone

THE UNUSUAL ANTENNA SYSTEM OF 6XBM

These two towers, originally built for high-voltage power lines, are surmounted by wooden poles between which the transmitting antenna of the station is stretched. The antenna is 150 feet long and is built of six cables in the form of a hexagonal cage; the six-pointed forms that are used to insulate the cables from each other are made of porcelain rods.

a tuned primary-circuit condenser and a small variable condenser.

The two antennas form an interesting part of the equipment. They are approximately 85 feet above the ground, stretched between two wooden poles atop towers built originally for the high-voltage power lines. With the longer of the antennas, made of six cables 150 feet long and arranged in a hexagonal cage, frequencies from 125 to 1,000 kilocycles can be transmitted; by means of the shorter, similarly built but only 25 feet long, it is possible to send all frequencies from 1,200 to 6,000. Porcelain rods insulate the antennas.

Two counterpoises extend from the building, one 220 feet long and consisting of four cables spaced four feet apart. This is used for lower frequencies. The shorter, or six wires spaced six feet apart and 60 feet long, is used alone for high frequencies, or in combination with the longer counterpoise for frequencies between 125 and 1,350 kilocycles. The longer counterpoise is four feet above the ground, the shorter ten.

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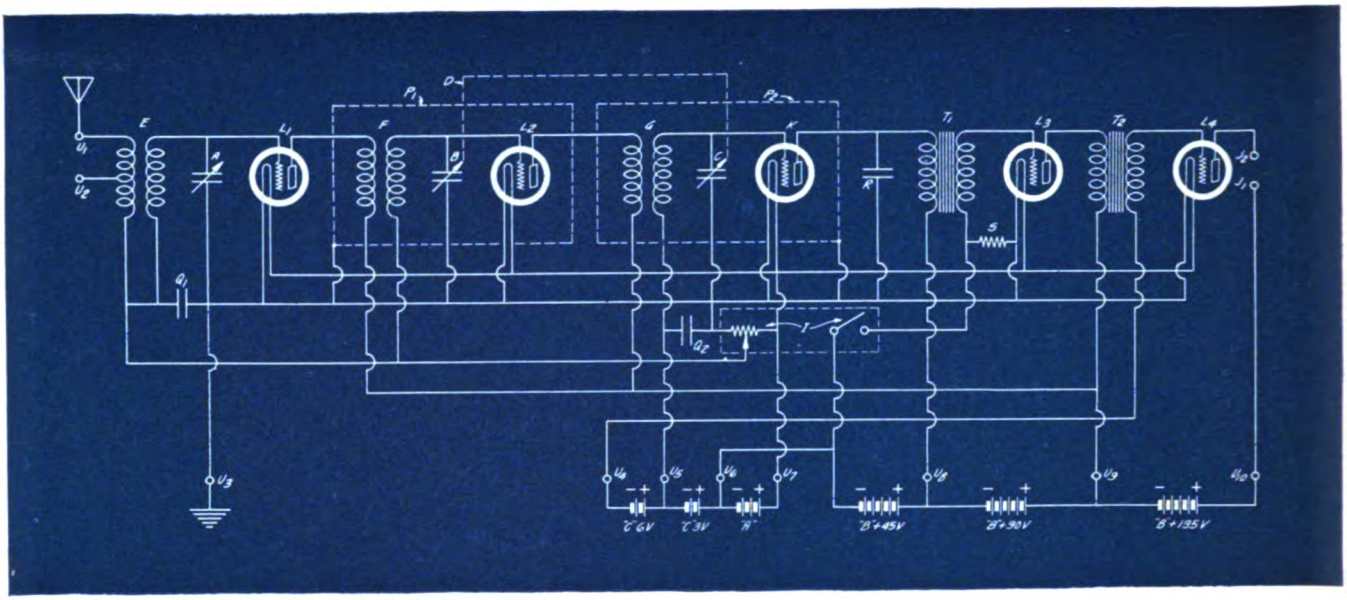

THE SCHEMATIC WIRING DIAGRAM OF THE SC-II RECEIVER

FIGURE 1: *The electrical circuit used is simplicity itself. The two condensers, B and C, are connected together by a link motion, shown at D. Both the second high-frequency stage and the detector stage are in shielded cans. The detector circuit uses plate rectification with a C bias.*

HOW TO BUILD

The New SC-II Receiver

All the newest ideas in receiver design—metal chassis, complete shielding, high-quality amplification—are features of this new "big brother" of the popular S-C Receiver. And it's just as easy to build.

By McMURDO SILVER and LAURENCE M. COCKADAY

COST OF PARTS: *Not more than $62.00*

THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS RECEIVER ARE—

A—S-M variable condenser, type 316-A, .00035 mfd.;
B and C—S-M variable condensers, type 316B, .00035 mfd.;
D—S-M link-motion unit, No. 637;
E—S-M antenna coupling coil, No. 116-A;
F and G—Interstage high-frequency coupling coils, No. 118-A;
H1, H2 and H3—S-M coil sockets, No. 515;
I—Carter potentiometer switch, type M-200-S;
J1 and J2—Any approved tip jacks (Carter No. 10 tip jacks illustrated);
K—Benjamin cushion socket;
L1, L2, L3 and L4—S-M UX-type sockets;
M1 and M2—National vernier dials, type B, clockwise rotation;
N—Van Doorn decorated metal panel for the SC-II receiver;
O—Van Doorn stamped metal chassis for the SC-II receiver, including nuts, screws and insulators;
P1 and P2—S-M aluminum stage shields, No. 631;
Q1 and Q2—Any approved by-pass condenser, 1 mfd. (Polymet condensers illustrated);
R—Any approved mica fixed condenser, .002 mfd. (Polymet condenser illustrated);
S—Carter resistor, .5 ohm, type H-½;
T1 and T2—S-M low-frequency transformers, No. 220;
U1, U2, U3, U4, U5, U6, U7, U8, U9 and U10—Any approved binding posts (Eby binding posts illustrated). Posts should be marked *Ant., Ant., Gnd., A Bat. +, A Bat. —, C Bat. +, C Bat. —, 45 Volts +, 90 Volts +, 135 Volts +*;
1 set of POPULAR RADIO blueprints.

THE popularity of the original S-C receiver, the constructional details of which were published just a year ago in POPULAR RADIO, has convinced the authors that there is a large interest in low-priced receivers, incorporating the newest ideas in radio design and construction, among the radio fans who are experimenters and who enjoy building their own sets. It was with this idea in mind that the design work on the SC-II receiver was carried out by the authors.

Complete shielding was used in this new model, with high-efficiency coils of the spaced-winding type. The circuit employed is the standard two stages of tuned-high-frequency amplification with a vacuum-valve detector and two stages of low-frequency amplification using transformer-coupled units especially designed to bring out the low notes faithfully, as well as the higher ranges, and a power tube in the last stage to insure a really good quality of reproduction.

It was further decided to use, as embodied in the better and later designs of high-priced receivers, a metal chassis and sub-panel. The receiver has also been laid out so that the "bunched" or "cabled" idea of wiring could be easily done at home by the constructor.

The latest idea of shielding the detector and second stage to prevent coil pick-up has been incorporated in the design.

The tuning of the second stage of

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high-frequency amplification and the detector is done by means of a single-control, mechanical coupling device for the two condensers.

Both the metal panel and the metal chassis have been stamped with the proper holes, so that the instruments may be immediately bolted to them, using these holes.

The tuning is done by means of two selector dials of the variable-vernier type, located on the front panel, with a combination switch and volume-control knob located between them.

The control for tuning is exceptionally simple and the whole system provides adequate selectivity and sensitivity, even in these days of crowding of the broadcast frequencies.

The proper by-passing arrangements have been incorporated in the design and the circuits so arranged as to produce high efficiency in both the high-frequency and the low-frequency stages of amplification.

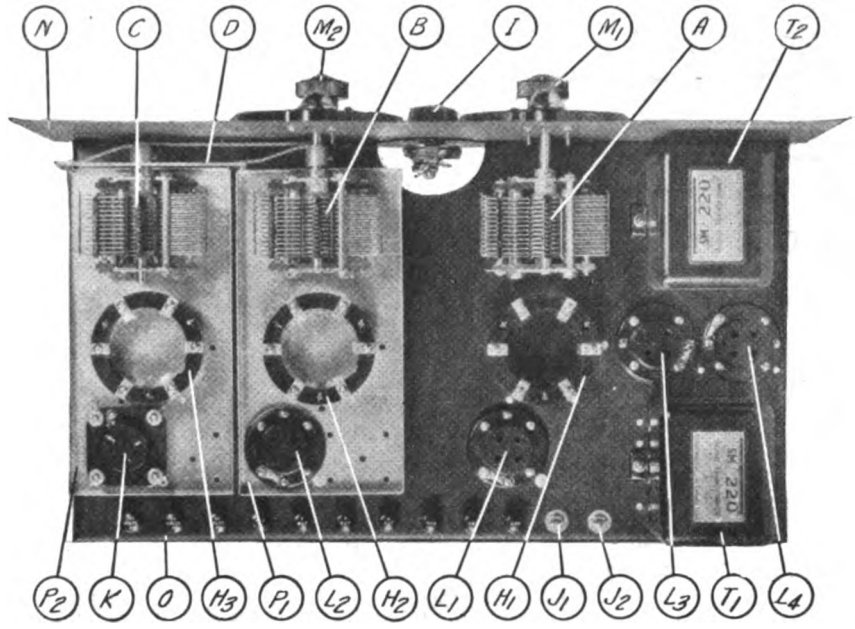
The circuit diagram for the receiver is shown in Figure 1.

How to Construct the Receiver

Figure 4 shows a plan view of the sub-panel, O, and a side view of the front panel, N, attached to it.

In this drawing, all of the instruments that are mounted on top of the sub-panel are shown in heavy black lines, while the instruments mounted below the sub-panel are outlined in dotted lines. The actual wiring is shown in red. This makes it easy to follow the drawing in wiring up the set.

As mentioned before, the holes for mounting the instruments are already stamped into the chassis sub-panel, O, and the instruments may be attached directly thereto, following the layout, as shown in this diagram and in the accompanying photographic illustrations.

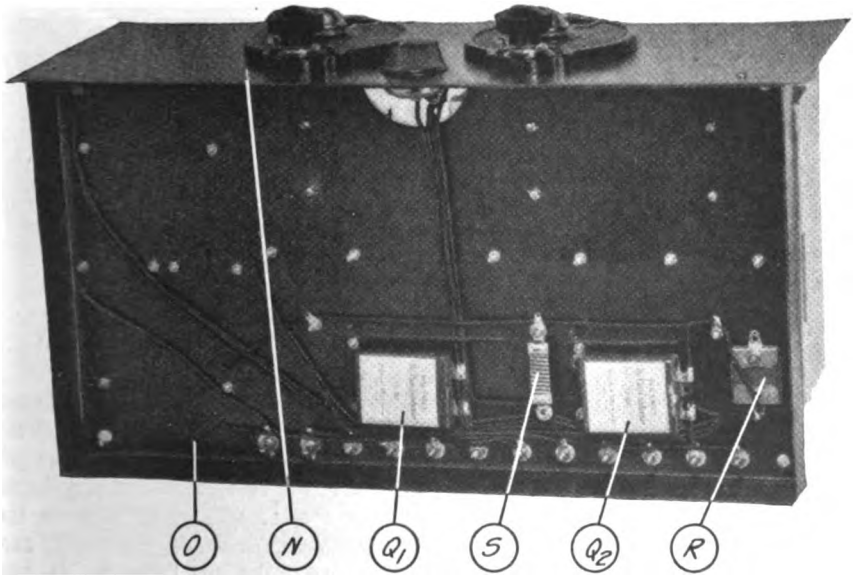


A VIEW OF THE SET FROM ABOVE

FIGURE 2: *In this picture the shields have been removed from the second stage of the high-frequency amplifier and the detector stage, to show the arrangement of the parts. The coil sockets are in place, but the coils have been left out of the sockets.*

The construction is so simple and the pictures and drawings so complete, that no extensive description is necessary and a few remarks will cover this phase of the constructional work.

The first job is to mount the two shield bases, P1 and P2, and to mount the valve sockets, K and L2, at the same time as the coil bases, H2 and H3, and the two condensers, B and C. Note that the coil bases are mounted on metal collars so that they stand clear of the shield.



HOW THE RECEIVER LOOKS FROM BELOW

FIGURE 3: *This view shows the metal chassis with the condensers and resistances that are mounted on the bottom side of the sub-panel.*

Next, attach the link-motion unit to the two condensers, B and C. Then mount the two transformers, T1 and T2, and the condenser, A, with the remaining coil socket, H1, and the remaining vacuum-valve sockets, L1, L3 and L4.

The unit may then be turned over bottom-side-up and the two by-pass condensers, Q1 and Q2, the small fixed condenser, R, and the resistance, S, fastened securely. All of the instruments may be attached in their correct positions by means of the bolts and screws furnished with the metal chassis. The two dials, M1 and M2, should be attached to the panel and the two top studs on each dial inserted through the panel and tightened with nuts. The panel should then be slipped in place and fastened by means of two screws to the two holes drilled for this purpose in the metal chassis. The bottom bolt of these dials is not to be fastened until the panel, N, is attached to the metal chassis, O, when they both may be tightened up with two nuts in back of the bottom side of the chassis.

Fasten the potentiometer switch, I, to the panel, N, and the flap of the chassis, X. Be careful to insulate this switch from the chassis by means of the insulating washers that are supplied with the panel.

Next, the dials may be tightened to the shaft of the condensers by means of the set screws with the condensers fully meshed when the dial readings register "0," which is the same point as "200" on the scale. An arrow points to this position.

When the binding posts, U1 to U10,

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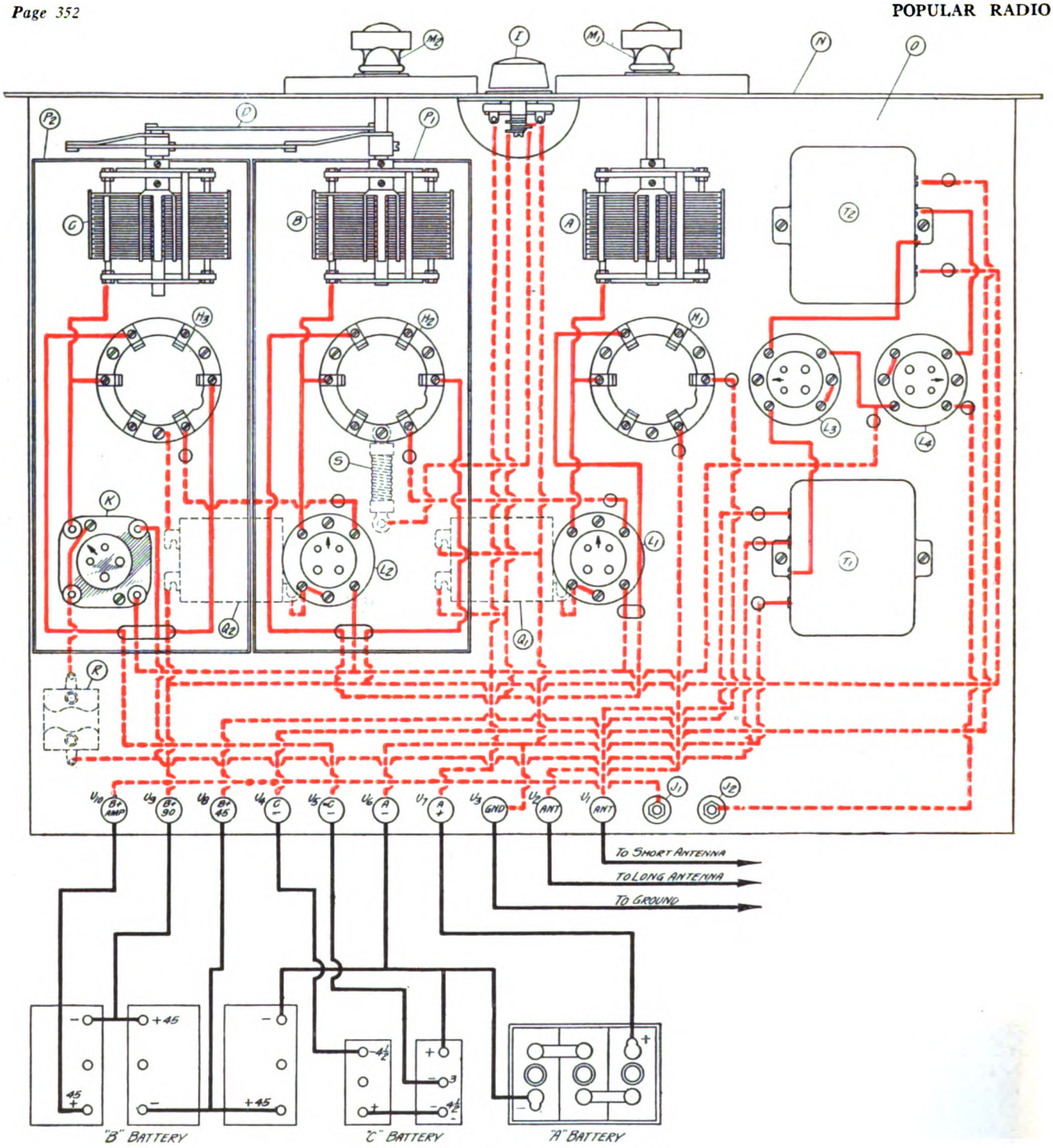

THE PICTURE WIRING DIAGRAM

FIGURE 4: *This drawing shows the relative layout of the instruments and the construction of the set; the instruments are shown in black, with all of the wiring in red. The solid red lines indicate the wiring that is done on top of the metal chassis; the dotted lines indicate the wire that runs underneath the sub-panel. The battery connections and the connections to the antenna and ground are also shown.*

inclusive, and the two tip jacks, J1 and J2, have been attached, the constructional work is complete. Notice that all of the binding posts and the tip jacks should be insulated from the metal sub-panel, O, by means of the small washers that are packed with the sub-panel itself. In Figure 4 the arrangement of the binding posts is clearly shown and the proper markings for the posts are given.

The set is now ready to be wired.

How to Wire the Receiver

This is really a very simple job, as all the wiring may be done with flexible wire. There are no precautions to be observed, except that the low-potential wiring should be pulled through the ⅜-inch holes found at the rear of each high-frequency stage assembly of the set.

The leads connecting the plate of the high-frequency vacuum-valve to the primaries of the next high-frequency transformer are, as will be seen from the bottom view, shown in Figure 3, carried through the metal chassis, O, and then along it to a point ½ inch below the chassis in order to keep the capacity

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from plate to filament as low as possible.

The plate lead from the detector valve, K, to the primary of the first low-frequency transformer, T1, runs from the condenser, R, one end of which is fastened to the shield by a mounting screw, along the chassis away from the other wiring and then up through the hole to the transformer, T1. It will be noticed that this wire is held in place by three lugs that are in turn held by the mounting screws, thus keeping it in a definite position and away from the balance of the wiring. This is all shown in Figure 3.

The wire used in hooking up the set may be either the Kellogg insulated hook-up wire, Corwin or Belden rubber-covered wire or flexible Celatsite.

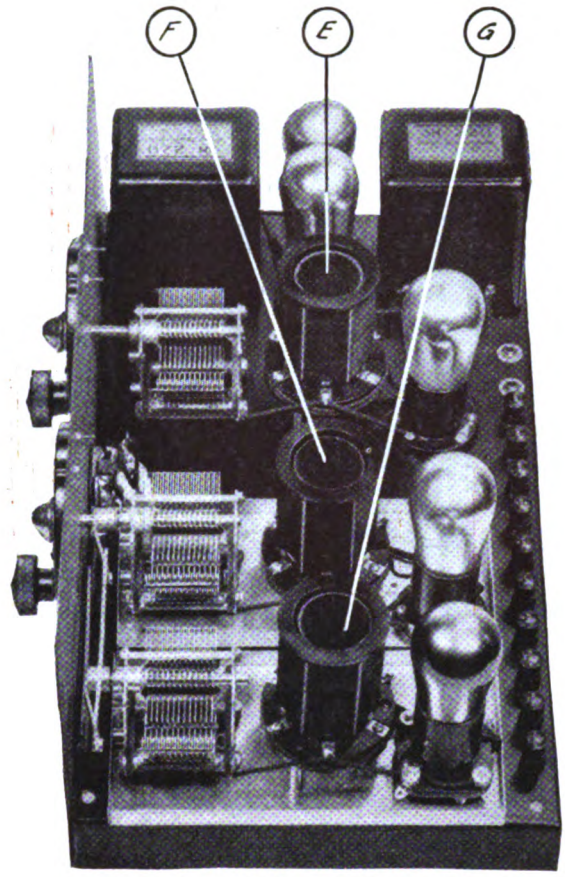
When the wiring is finally completed, after following the details shown in Figure 4 and the accompanying photographic illustration, the schematic circuit, as shown in Figure 1, will be complete and the set is ready for installation.

How to Install the Set

Place the receiver in its cabinet and insert the vacuum valves in their proper places.

Insert UX-201-a type tubes in valve sockets K, L1, L2 and L3. Then insert a UX-112 or a UX-171 type valve in the last stage socket. Next, insert coil E in socket H1 and coils F and G in coil sockets H2 and H3. Be sure that these coils are placed in the correct sockets, or trouble may be experienced.

Next, connect up the batteries as indicated in Figure 4. Three blocks of 45-volt "B" batteries, two blocks of 4½-volt "C" batteries and a 6-volt storage battery are necessary with the UX-112. With a UX-171 type valve higher "C" voltage is required. The ground wire should be connected to binding post U3 and, if a short antenna is used, it should be connected to binding post U1. If, on the other hand, a long antenna is to be used, it should be connected directly to binding post U2.



A RIGHT END VIEW OF THE RECEIVER

FIGURE 5: *This picture shows how all of the instruments on top of the chassis are mounted. Notice that the binding posts and the two loudspeaker tip-jacks are mounted in a row along the back with insulating bushings.*

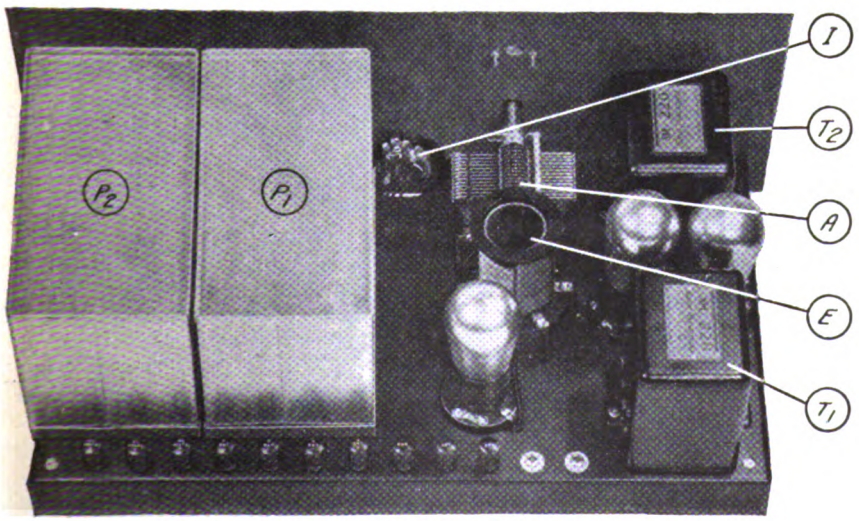
Next, insert the reproducer cord tips in the two tip-jacks, J1 and J2. Then place the top section of the shields, P1 and P2, in their proper places and the set is ready for operation.

How to Tune the Receiver

All tuning is accomplished by means of dials M1 and M2. As stated before, dial M1 tunes the antenna stage and dial M2 tunes the second stage of high-frequency amplification and the detector input circuit. The dial settings for these two controls is approximately the same throughout the entire range.

To start the receiver in operation, turn the potentiometer switch, I, in a clockwise direction over to the right until the vacuum valves light up to their correct brilliancy. The control, I, may then be used as a volume control while tuning in the two dials, M1 and M2, until a station is brought in to a maximum strength, when the control, I, may be turned back to give the proper volume.

The tone quality of the receiver in actual tests was exceptionally pleasing. And the authors feel sure that the receiver will give worthwhile results for the amount of money spent on it.



A REAR VIEW OF THE SET

FIGURE 6: *In this picture the cans are in place and the tubes are in their respective sockets. The two low-frequency transformers and their respective tubes are at the extreme right.*

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¶ Five interesting and worth-while experiments that show the amateur how to use a single meter for making measurements that involve resistance, current and voltage.

HERE IS A LABORATORY THAT ANY FAN CAN DUPLICATE

With only the instruments shown above—a pair of headphones, a simple receiving set and just one meter—the author made all of the experiments that are described in this article.

PRACTICAL HINTS FOR STARTING

Your Radio Laboratory

How to Make Your Voltmeter Do the Work of Several Instruments

By PAUL L. RITTENHOUSE

A REAL experimental laboratory is the goal of nearly any dyed-in-the-wool radio fan who is interested in more than just listening in. But there is one stumbling block that nearly every prospective experimenter runs into—the expense of laboratory instruments.

But there is a way to get around this obstacle by making one instrument serve the place of many.

With the aid of a little ingenuity, an inexpensive volmeter, costing only eight or ten dollars, may be used to perform many experiments involving measurements of current, resistance and voltage.

A few of these experiments which are of general interest, are described in this article; the fan may easily discover other applications.

First of all, however, he should have some knowledge of the principles involved.

Practically every small voltmeter is energized by a comparatively small flow of current (usually 5 to 25 milliamperes, or thousandths of an ampere) and has a fairly high resistance added to the resistance of the actuating coil, for this purpose. Direct-current voltmeters usually have from 50 to 150 ohms resistance for each volt on the scale.

It is necessary first to find out just what the ohmic resistance of the meter is. The manufacturer usually has a record of the resistance noted with the serial number on the name-plate, or it will be measured at small expense by any electrical laboratory.

Let us suppose that we have a Weston type 280 voltmeter and that the resistance on the 30-volt scale is given as 1673 ohms, or 55.77 ohms per volt. Applying Ohm's law,

$$\frac{Volts}{Ohms} = Amperes$$

we find that

$$\frac{30 \text{ volts}}{1673 \text{ ohms}} = .018 \text{ amperes}$$

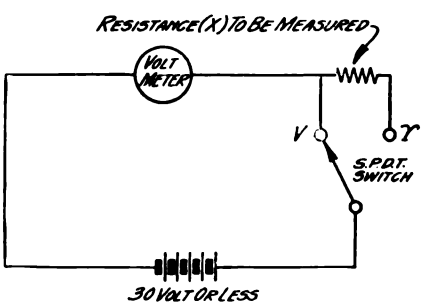

FIGURE 1: *This simple diagram shows how the unknown resistance should be connected to determine its exact value.*

or 18 milliamperes (discarding a negligible fraction) As the deflection of the needle is directly proportional to the flow of current, we know that if we add a resistance of 1673 ohms into a direct-current circuit with the meter and a battery with 30 volts, the resistance will become 3346 ohms and the current flow will be reduced to .009 amperes or half, with a reading of 15 volts. On this basis a formula can be made, to use in measuring any unknown resistance (within certain limits, as explained later), as follows:

$$X = \frac{(V-\gamma)R}{\gamma} \text{ where}$$

X is the unknown resistance;

V is the reading with the meter only in circuit;

γ is the reading with the meter and the unknown resistance in circuit;

R is the resistance of the meter.

EXPERIMENT NO. 1: *Testing the Resistance of Headphones.*

Let us try out this principle in practice starting on two pairs of headphones to compare their respective resistances. We know that a steady flow of current, through the coils of wire in the phones, will not meet the same resistance as an alternating flow, or even the pulsating

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current from our "B" battery, as rapidly changed in ampere value through the action of the last low-frequency amplifying tube in our radio set. But the difference in direct-current (DC) resistance between our two pairs of phones will be approximately proportionate to the difference between their resistances as used in the set.

So we make the circuit connections shown in Figure 1.

For telephones A we find:

R = 1673 ohms (known voltmeter resistance).

V = 20.5 (reading on 30-volt scale, without unknown resistance in circuit).

γ = 10.0 (reading on 30-volt scale, with unknown resistance in circuit).

$$\text{Resistance } X = \frac{(20.5\text{-}10)\ 1673}{10} = \frac{17566.5}{10} = 1757 \text{ Ohm}$$

For telephones B we find, following the same procedure:

V = 20.5

γ = 8.5

X = 2362 ohms

So we know pretty well why telephones B cost $10.00 while telephones A cost only $4.75.

Experiment No. 2: *Determining Antenna Leakage.*

One evening we find that when listening to a local station the audibility seems low, so we determine to find whether there is leakage from the antenna to ground, which seems possible because it is raining in torrents. Connecting the antenna and ground wires in place of the telephones in the above circuit, we find that the resistance is 58,000 ohms. A little later the rain stops and we find that the antenna-to-ground resistance has increased to 113,000 ohms. So we measure again the following evening when the antenna insulators are dry; this time we find that we cannot even get a deflection.

We naturally want to know what this wet-weather leakage means in DX work so we take a variable resistance that we have in our second set, marked for maximum of 250,000 ohms, and move the sliding contact until we get the same deflection as when the wet antenna was connected in our circuit, with the ground. This gives us the same resistance as antenna-ground resistance. To find out what this much leakage means in DX work, we connect the resistance across the antenna and ground binding posts in our tube set, with a distant station tuned in, and find that the volume is greatly decreased.

This wet-weather leakage from antenna to ground must go, so the next good Saturday afternoon we do some climbing and put two good porcelain insulators at each end of our antenna, and one to a guy wire connected just where the lead-in wire comes to the top of the window, to keep it away from the bricks. And the trouble is cured.

Experiment No. 3: *Testing the Efficiency of Crystal Types as Detectors.*

Next we become impatient one evening when we realize that the light contact of the crystal detector catwhisker gets out of adjustment all the time. We have read somewhere that a carborundum detector is used with a heavy contact that does not have to be changed, so we buy a carborundum detector. Then we decide to measure the resistances of both the old crystal and the carborundum. Connecting the crystal detector in the test circuit with the battery current flowing from crystal to catwhisker, the resistance figures 284 ohms. With the detector connections interchanged in the test circuit, however, the resistance measures only 84 ohms. We know that a crystal detector is a valve that, in effect, allows current to flow only in one direction, from catwhisker to crystal, but that in reality there is only a difference in resistances in the two directions, this difference giving the detector action.

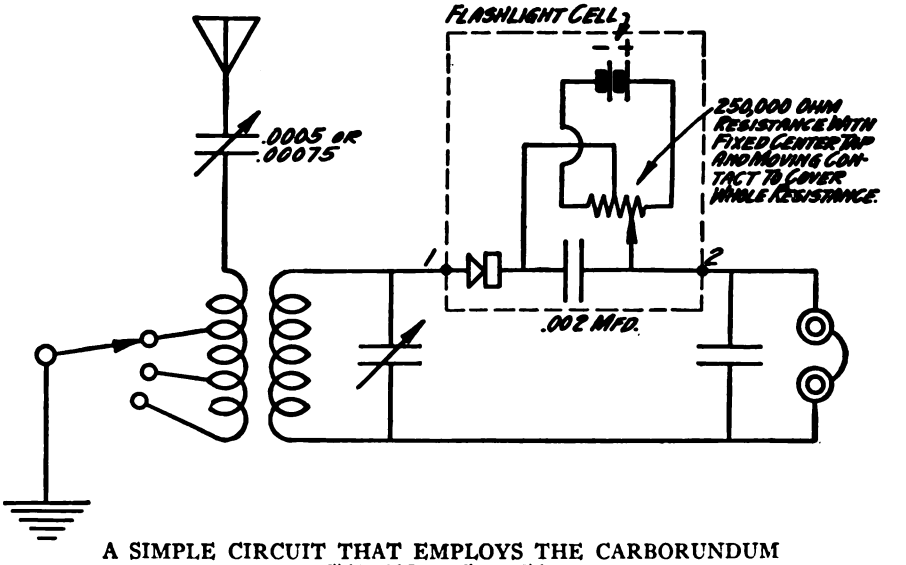
Having gotten this far, we test the carborundum detector and find that the resistances in both directions are, respectively, 1395 ohms and 742 ohms. When we substitute the carborundum detector in our crystal set, it seems that the secondary circuit tunes much sharper; but the volume is cut down on the weaker stations. But being interested to find out what this is all about, we go to the library and dig out an article by a research man in the Carborundum Company, which points out that the higher resistance of the carborundum detector is a disadvantage that does not offset the advantages of sharper tuning and a firm, permanent contact, but that, by the use of a stabilizing circuit, shown in Figure 2, with the carborundum detector, with a flashlight cell, fixed condenser and a tapped resistance, we can get the advantages and overcome the disadvantage of the high relative resistance.

Experiment No. 4: *Determining the value of a "C" Battery in a Set.*

The next experiment is to determine the value of a "C" battery in our tube set, as we have heard a good deal about the economy of a "negative biasing voltage." If we happen to have, for instance, a Weston type 280 meter, there is a binding post marked "1 volt." Using Ohm's law we figure that, at 55.77 ohms per volt reading, there are 5.577 ohms in the one-tenth voltmeter circuit, and dividing this into .1 volt, we get .018 amperes, or 18 milliamperes flow of current with full reading, which is the same figure that we got from dividing through for the 30-volt scale. Dividing 30 into 18 milliamperes, we find that each volt reading on the 30-volt scale will represent .0006 (6/10th milliampere). Connecting the .1-voltmeter circuit into our "B" battery circuit, we find that our meter reads 14 volts on the 30-volt scale, which, multiplied by .6 gives 8.4 milliamperes flow for the three UX-199 type tubes without "C" battery bias on the grid.

Connecting a 4½-volt "C" battery into the grid return circuits of all three

(*Continued on page 390*)



A SIMPLE CIRCUIT THAT EMPLOYS THE CARBORUNDUM STABILIZING UNIT

Figure 2: *In his measurement of crystal resistances, in Experiment No. 3, the author found that carborundum offers a relatively high resistance that cuts down volume on the weaker stations. This disadvantage, however, may be overcome by the use of the stabilizing circuit shown above within the dotted line.*

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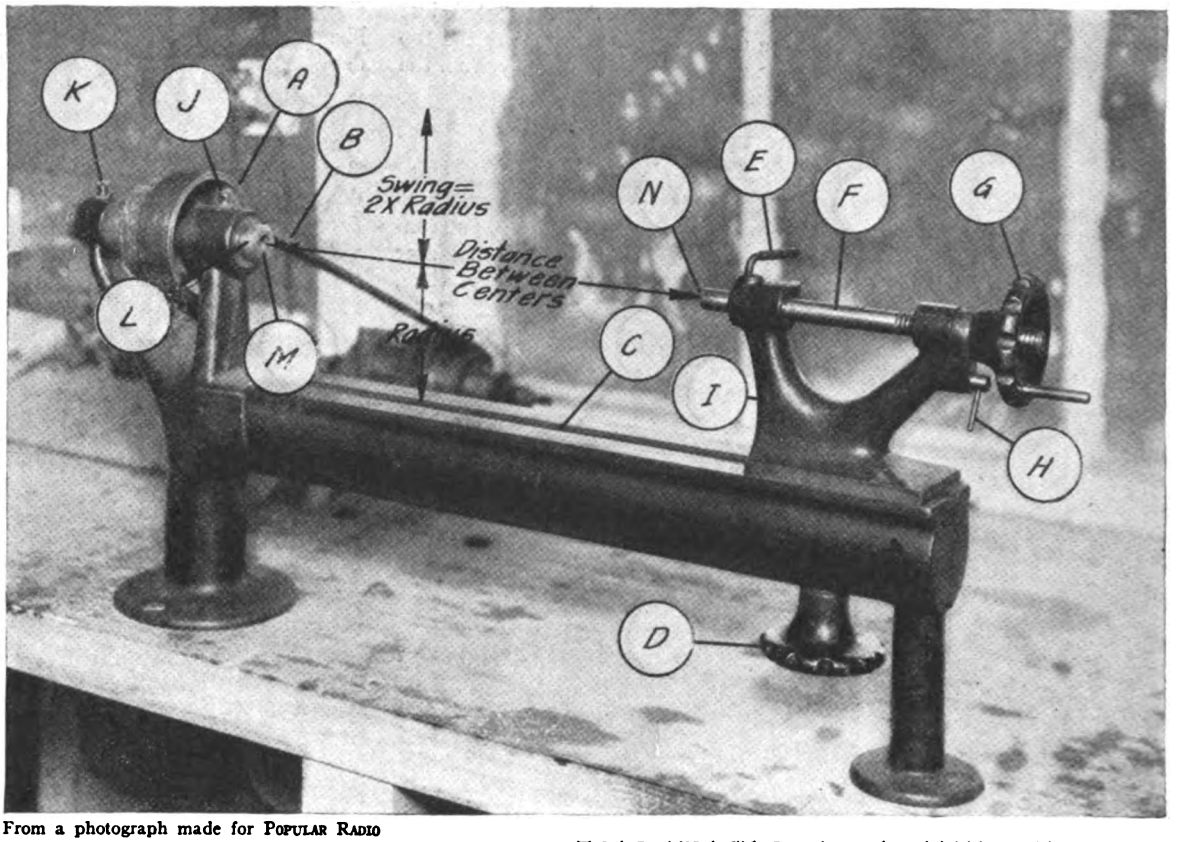
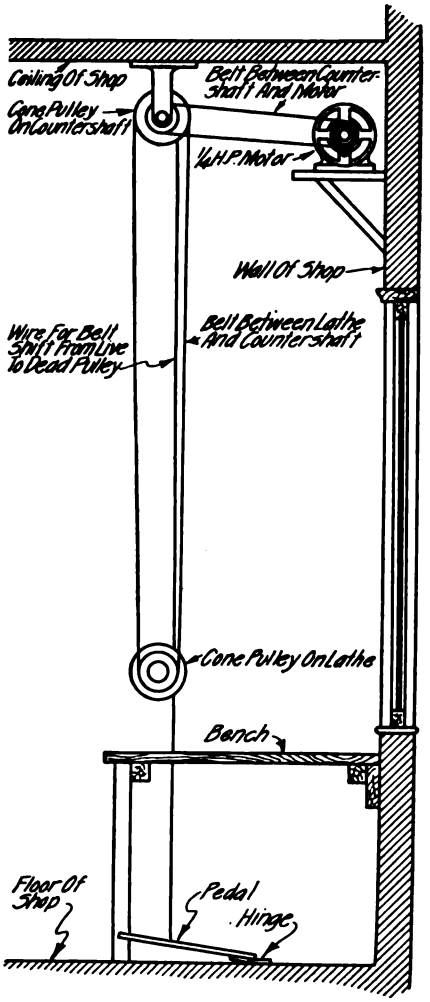


From a photograph made for POPULAR RADIO

THE LATHE STRIPPED OF ACCESSORIES

FIGURE 1: *This picture gives a good idea of the lathe proper. The letters indicate the following parts: A is the cone pulley; B, the live spindle; C, the milled bed; D, the clamping nut for tail-stock; E, the lock screw for tail-stock spindle; F, the tail-stock spindle; G, the hand feed screw for tail-stock spindle; H, the screw feed release for tail-stock spindle; I, the tail-stock main casting; J and K, the live spindle oil cups; L, the threads on live spindle; M, the live center, and N, the dead center.*



HOW TO SET UP THE LATHE

FIGURE 2: *This will give the amateur millwright and lathe operator an idea of the best way to set up his equipment. Note that the lathe is not shown, but merely the position of the cone pulley.*

YOUR

Laboratory Tools

ARTICLE No. 1

How to select, install and operate a small lathe in your experimental laboratory.

By LOWELL MADDEN, JR.

A SMALL bench lathe not only greatly increases the range of work that may be handled in the radio experimenter's shop, but it makes the owner less dependent on hand tools for the accomplishment of jobs that should really be done by the use of power. The lathe is the master tool and with it the mechanic may work faster, surer and more accurately.

While the ingenious application of hand tools will make the radio experimenter more or less independent of a lathe, he wastes a great deal of time in rigging up makeshifts that, no matter how carefully employed, mark his work as coming from the hands of a novice. In a jiffy, a lathe may be set up for grinding, polishing, sawing, screw cutting, metal turning, wood turning, buffing, spinning, knurling, fret sawing, coil winding or drilling. In each one of these operations, the mechanic is able to exercise greater control over his work and, by placing the burden of power entirely upon an electric motor, his capacity is multiplied manifold. It is true that a small hand drill may be used for winding small coils, drilling panels and polishing small bits of metal, but how much more

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quickly and accurately these jobs may be done on a lathe!

In purchasing a lathe, the experimenter should not only be guided by his actual needs but by certain mechanical features that mark the good tool. There are but two dimensions on a lathe that determine its size and capacity for work. One of these is what is called the "swing" of the lathe. This determines the size of a piece of work that may be revolved between its centers. Of course, the matter of weight enters into the question. One could not expect to revolve a hundred-pound piece of steel between the centers of a small tool, such as the one we have under consideration.

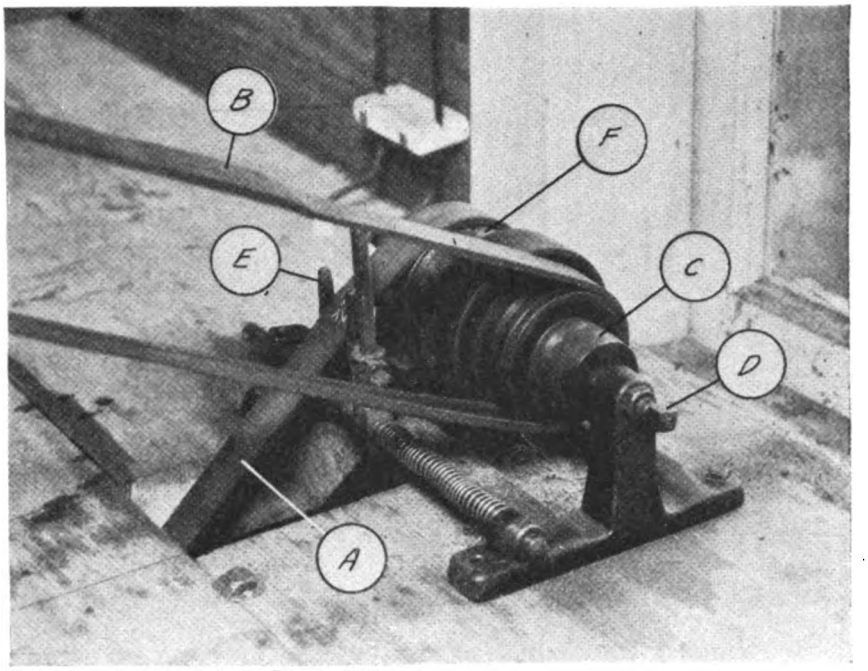
The distance between the centers (centers are indicated at MN, Figure 1) of the lathe and the lathe bed is called the "radius" and this multiplied by 2 gives the swing. The other measurement, that fixes the size of the lathe, is the distance between centers; that is, the distance between the live and dead centers when the tail stock of the lathe occupies the position at the extreme end of the bed, as illustrated in Figure 1.

The particular lathe under consideration is a Goodell-Pratt No. 125, which has a maximum distance between centers of 12 inches and a swing of 7 inches. This particular lathe was taken as a good example of a radio experimenter's tool, not only because of its size and good mechanical features, but because it may be equipped with a large variety of attachments that greatly increase its range of work. Save for two centers, the tee rest, slotted face plate, a table rest, saw arbor, tail feed handle and a drill chuck with a No. 1 Morse tapered shank, all other attachments, such as fret saws, scroll chucks, slide rests and circular saws, must be purchased separately. However, when all of these devices are available, the experimenter has at his disposal what practically amounts to a small machine shop.

One important feature to look for in the purchase of a lathe is cone bearings on the live spindle. This is the spindle marked "B" in the diagram (Figure 1). In Figure 4, the live spindle has been removed to show the conical shape of the bearings. A and B are the coned or tapered portions; A is a slight taper while B is an abrupt one. The cone collar B is screwed on to the live spindle and by adjusting this, the wear on the bearings may be taken up from time to time. Although the bearings may wear, they are always kept in perfect center and free of play by this ingenious arrangement.

The second important feature which determines the quality of a tool is the milled bed. Since the tail-stock of the lathe rides upon the bed, the accuracy of any work turned out will depend largely upon the uniform surface of this part. The experimenter should also be careful to see that the tool is equipped with plenty of oil and grease cups so that it may be oiled plentifully. Oil is cheaper than lathes and unless a

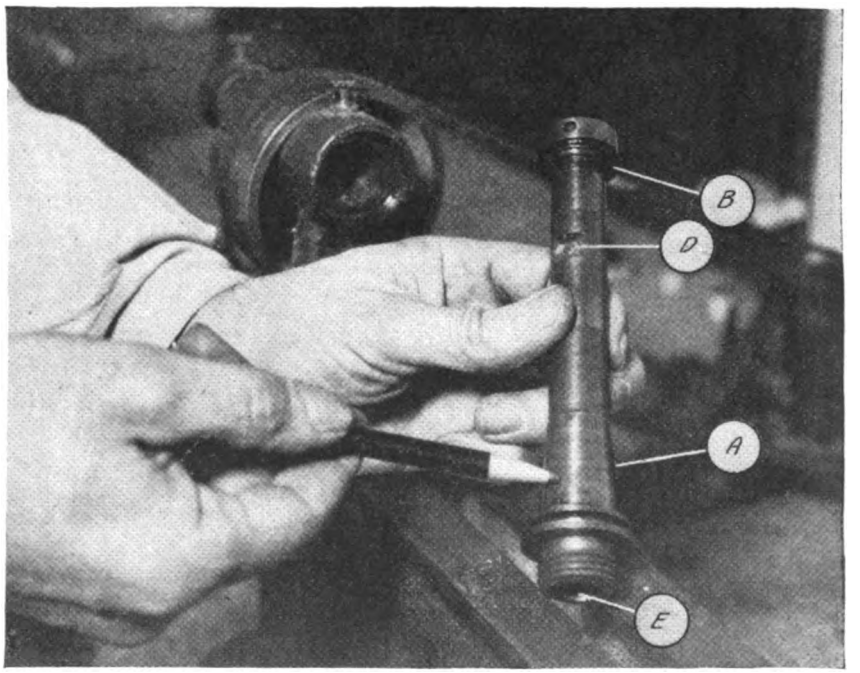
(*Continued on page 392*)



From a photograph made for POPULAR RADIO

THE POWER PLANT OF THE LATHE

FIGURE 3: *This illustrates one way of installing a small countershaft of the lathe described. The power motor (¼ hp) is inverted under the bench and connects with the countershaft by means of a belt, A. Belt B connects the cone pulley of the lathe with the cone pulley of the countershaft; F marks the power pulley while D marks the bearing adjustment. E refers to the forked belt shift.*



From a photograph made for POPULAR RADIO

WHAT THE LIVE SPINDLE LOOKS LIKE

FIGURE 4: *By removing the live spindle from the lathe, the mechanic will easily learn how to keep the bearings in adjustment. A points to the long taper; B, to the conical-shaped collar which is screwed to the end of the live spindle. By adjusting the latter, wear in the bearings may be taken up. D shows the flat for the set screw which holds the cone pulley in place and E points to the hole in the spindle.*

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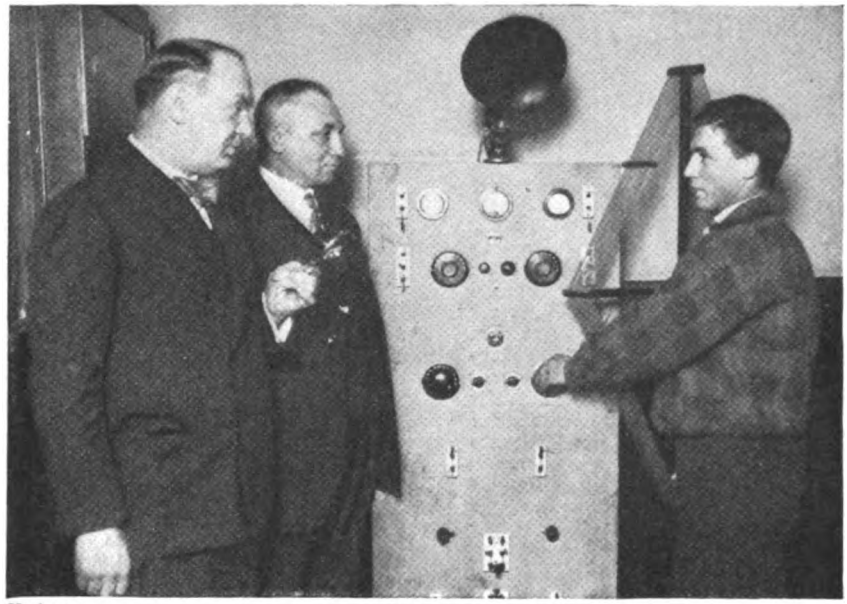

Herbert

Pocket Radio Sets to Help Police Catch Crooks

Here is the radio transmitter that has been designed to keep the police of Passaic, N. J., in touch with headquarters as they patrol their beats; the officers will pick up its transmissions on small, portable receivers. Michael Rusch (at right) is the creator of this system.

What's New *in* Radio

Conducted by
THE TECHNICAL STAFF

Inventors, experimenters, manufacturers and readers generally are invited to keep the Technical Staff of POPULAR RADIO informed of all new apparatus that is of their own creation or that comes to their attention; if the apparatus passes the tests of the POPULAR RADIO LABORATORY it will be duly recorded in this Department for the information and benefit of all.

This Audio Coupler Enables You to Get Good Volume With Fine Tone

Name of instrument: "Truphonic" low-frequency coupler.

Description: This instrument is entirely inclosed in a metal case and is equipped with flexible leads by means of which the unit may be connected into the circuit of the low-frequency amplifier. These leads are clearly labelled to prevent confusion. Mounting feet are provided for attaching the unit to the baseboard or sub-panel of the receiver. The unit consists of two coils on a single core and a fixed capacity, shunted across the high potential ends of the coils.

Usage: To provide coupling between the vacuum valve circuits of a low-frequency amplifier.

Outstanding features: The "Truphonic" method of coupling is something comparatively new, but still old enough to have proven that it has decided merit. This type of coupling combines many of the advantages of the various other types of coupling systems. The quality of reproduction obtained with the use of this system of low-frequency amplification is excellent. The units are unusually compact and are simple to install and connect up. Three stages of such amplification are used.

Maker: Alden Manufacturing Co.

A Device to Insure Quiet Tube Operation

Name of instrument: Vacuum valve vibration repressor.

Description: This cap is molded of heavy, soft rubber with slits in the side to permit slipping it down over the top of a vacuum valve. The spring action of the rubber causes the cap to hug the valve snugly; this improves the repressor action.

Usage: To eliminate microphonic howls in a radio receiver.

Outstanding features: The springy action of the rubber causes the cap to conform exactly to the shape of the valve. Good appearance. Heavy weight. Stops howling in a low-frequency amplifier.

Maker: Spartan Electric Corp.

For Antenna Connections Where Soldering Is Impractical

Name of instrument: Aerial connector.

Description: This device consists of a nickel-plated, brass strip, which is provided with screw clamps at each end. In connecting a lead-in wire to the antenna, the lead-in wire is fastened into one end of this device and the antenna is clamped into the other end. This makes a solid physical joint as well as a good electrical connection between the antenna and the lead-in wire.

Usage: To attach the lead-in wire to the antenna wire.

Outstanding features: Simple in construction. Strong clamps. Good electrical conductor. Easy to install.

Maker: Heinemann Electric Co.

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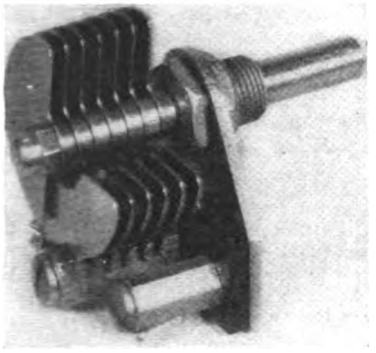


An Efficient Midget Variable Condenser

Name of instrument: Midget variable condenser.

Description: This condenser is well made, with its stator plates firmly crimped into a square metal post and insulated from the rotor plates and condenser frame by means of a small strip of insulating material on which the stator support is mounted. The rotor shaft has a single bearing, which is adequate for such a small condenser. The instrument is equipped for single-hole mounting and is provided with both screw connectors and soldering lugs.

Usage: As a balancing condenser for use in conjunction with two or more variable condensers in a gang to operate from a single control or for any other purpose where a small variable capacity is required.

Outstanding features: Extremely solid construction. Constant capacity. Strong bearing. Grounded rotor plates. Well insulated stator plates. Low minimum capacity.

Maker: Allen D. Cardwell Manufacturing Corporation.

High-Frequency Amplifiers May Be Easily Balanced With This Device

Name of instrument: Balancing unit for high-frequency amplifiers.

Description: This device consists of a variable high resistance and a fixed condenser which are enclosed within a composition case. A screw head is provided at the top so that the resistance may be adjusted by the use of a screw driver. The unit is designed so that it may be used for single-hole panel mounting or for base mounting. It is equipped with soldering lugs for making external connections.

Usage: In the plate circuit of high-frequency amplifier valves to reduce oscillation and stabilize the amplifier.

Outstanding features: Well constructed. Compact in size. Neat in appearance. Makes stabilization of high-frequency amplifiers a simple matter.

Maker: Electrad, Inc.

A Power Plant for a "B" Power-Pack

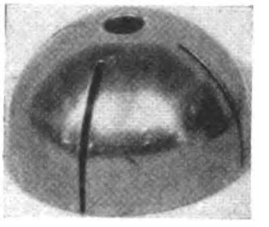
Name of instrument: Power transformer.

Description: This power transformer is designed to operate from the 110-volt, 60-cycle lighting lines. The secondary windings are all center-tapped and provide 300 volts for the plate supply and filament supply voltages of 5½ and 7½. The unit is completely inclosed in a pressed-metal case with a black crackle finish and is equipped with a composition terminal panel.

Usage: As the power transformer in any "B" power-pack which uses a gaseous or a filament type rectifier valve to provide the high voltage required for the plate supply of a receiver and also the filament voltages required for the operation of the filament type rectifier tube; and for the UX-171, the UX-112, or the UX-210 type power valves used in the last low-frequency amplifier stage of the receiver.

Outstanding features: Compact size. Provides all necessary voltages for use in a standard "B" power-pack, including the filament voltages for the rectifier and power amplifier tubes. Well made. Efficient.

Maker: National Company, Inc.



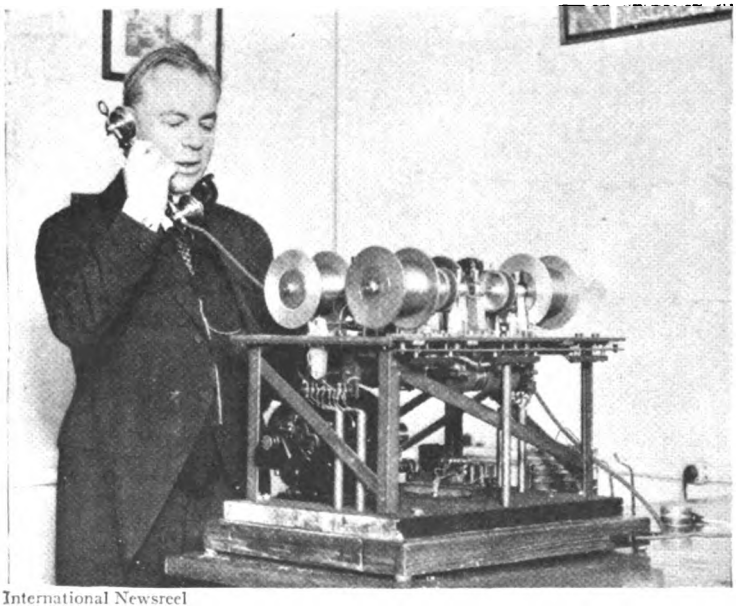
This Device Will Stop Microphonic Howls in Your Set

Name of instrument: Vacuum valve vibration repressor.

Description: This is a polished metal cap designed to fit over the top of vacuum valves. Four felt pads are glued to the inside to eliminate rattling which might occur if this cap fitted loosely on the tube. There are four slits which divide the cap into four segments and permit the segments to be adjusted to the exact circumference.

Usage: To be placed on vacuum valves to eliminate the microphonic howl which frequently occurs if the reproducer is placed too close to the receiver. Especially useful with UX-200-a type detector valves.

Outstanding features: Neat in appearance. Simple in construction. Nothing to break or wear out. Stops howling in a low-frequency amplifier.



International Newsreel

A Machine to Record Broadcast Programs

Radio programs may be literally "put on the wire" by means of this device which records sounds permanently on a threadlike wire; the sounds may be reproduced with the aid of a radio amplifier and an ordinary loudspeaker.

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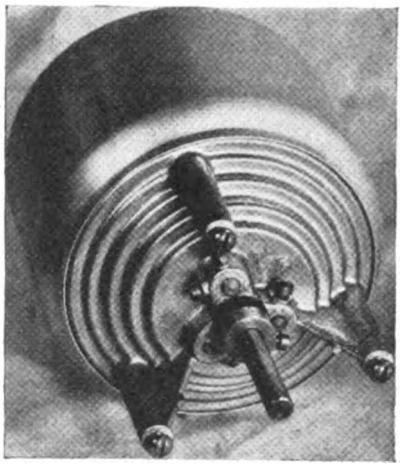


A Die-Cast Variable Condenser of Unique Design

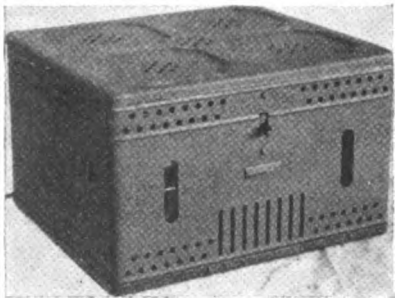
Name of instrument: Variable condenser.

Description: This condenser is out of the ordinary in that it does not make use of piled-up plates as does the usual variable condenser. The stator and slider (corresponding with the rotor in the ordinary condenser) are each cast in a single block. Each of these units consist of a casting which is made up of a series of concentric and alternate rings and grooves. The size of the two blocks is such that the rings of the slider mesh into the grooves of the stator and vice versa. The extent to which the two units are meshed governs the capacity of the condenser. The movement of the slider is a direction parallel with the control shaft. The entire condenser is completely inclosed in a metal case. The change from minimum to maximum capacity entails a 360-degree movement of the shaft.

Usage: As a variable tuning unit in a radio receiver or wherever a variable capacity unit is required.

Outstanding features: Great strength. Permanent characteristics. Good insulation. Extremely low DC resistance. Full 360-degree movement.

Maker: Furnell Mfg. Corp.



A Complete "A" and "B" Power-Pack in a Single Metal Case

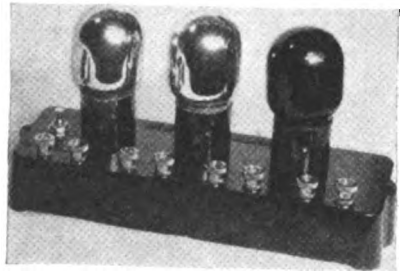
Name of instrument: "A" and "B" Socket Power.

Description: The brown crystalline-finished metal case which incloses this unit measures 12¾ inches by 13⅝ inches by 7⅞ inches. The unit consists of a small 6-volt storage battery with an electrolytic trickle charger, for the "A" supply and an electrolytic rectifier, filter and the necessary output resistances for the high-voltage, plate-supply of a receiver. The "Socket Power" will operate any receiver which uses eight vacuum valves or less. It will supply a maximum plate voltage of from 135 to 150 volts, depending on the current required by the receiver. The maximum practical plate current the device will supply is 50 milliamperes. The charging rate of the trickle charger may be regulated to meet requirements. The unit is supplied with an extension cord and plug, which in operation is plugged into any socket on a 110-volt, 60-cycle line. A switch is provided on the front of the case, by means of which the unit is turned "on and off." When turned "on" the "A" battery is connected to the receiver and the "B" supply section is connected to the AC line. When turned "off" the "B" supply is disconnected from the line, the "A" supply is disconnected from the receiver and is connected to the trickle charger. The "A" battery is therefore constantly on charge while the receiver is *not* in operation.

Usage: To supply the "A" and "B" voltages for the operation of a radio receiver.

Outstanding features: "A" and "B" supply devices complete in a single unit which is small enough in size to fit into the battery cabinet of a radio table or console. The "A" charging is automatic. Will operate any standard receiver, including those that use a UX-171 or a UX-112 type power tube in the last low-frequency amplifier stage. The entire unit requires no attention on the part of the owner except the occasional addition of distilled water to the solution in the battery and rectifier jars.

Maker: Philadelphia Storage Battery Co.



An Amplifier That Will Give Excellent Tone Quality From Any Receiver

Name of instrument: Low-frequency amplifier.

Description: This instrument, known as the Sonatron Amplifier, is a high-grade, three-stage, resistance-coupled, low-frequency amplifier. All of the parts except the vacuum valves are inclosed in a composition base. Terminals for connections to the batteries are provided along one edge of the base and provision is made for inserting the valves directly into the top of this base. A switch is also provided for turning the amplifier "off and on." Mounting holes at either end of this amplifier unit furnish means for fastening it down, if it is to be permanently included in a receiver. The three valves provided with the amplifier unit are especially matched. The first one is a "high-mu" tube with an amplification constant of 32. The second valve has an amplification constant of 20, and the third an amplification constant of 6 This set of tubes supplies high amplification with excellent tone quality. For purposes of identification the vacuum valves are colored red, white and blue respectively.

Usage: As a high-quality, low-frequency amplifier that can be readily connected immediately after the detector in any receiver, to provide loud-speaker reception of pleasing quality. It may be used to convert a single-valve receiver, or a crystal receiver, into one which will provide good reception on a cone-type reproducer, or it may be used in place of the amplifier in a receiver which is not giving a good quality of reproduction. In any case only one connection in the receiver need be changed to accommodate it, and in the case of a single-tube or crystal receiver, no wiring changes are needed.

Outstanding features: Compact. Easily installed. Fine quality of reproduction. Low current consumption.

Maker: Sonatron Tube Co.

An Accurate High Capacity For Use as a By-pass Condenser

Name of instrument: Fixed by-pass condenser.

Description: The condenser is made of special tinfoil and paraffin paper and is assembled in such a manner as to insure accuracy of capacity rating. The assembly is sealed into a metal can with two soldering-lug terminals brought out through the sealing compound at one end. Mounting lugs are provided at the other end for mounting the condenser in an upright position by means of screws or bolts. The condensers are made in various capacities from .2 mfd. up to 4 mfd. and are given a breakdown test of from 400 to 750 volts, DC.

Usage: As a by-pass condenser where the condenser is not subjected to voltages in excess of 200 volts.

Outstanding features: Rigid assembly and permanent capacity.

Maker: Kellogg Switchboard and Supply Co.

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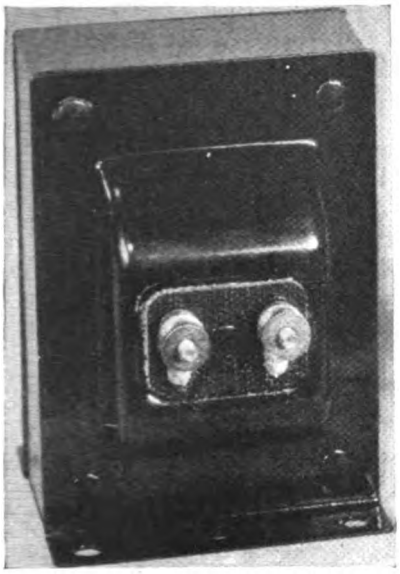


A Transformer to Provide Truthful Tone Quality

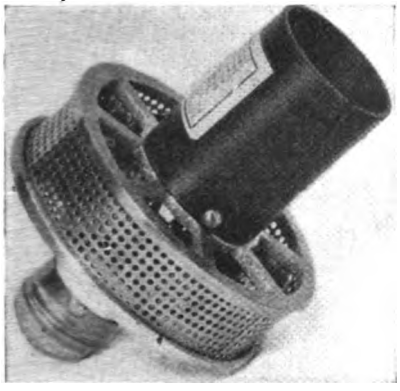
Name of instrument: Low-frequency transformer.

Description: This instrument is of generous proportions; this is one of the reasons for the fine quality of reproduction obtained from receivers in which this transformer is used. The instrument is entirely enclosed in a metal case except for the two small insulating panels on which the terminals are mounted. A flanged base is provided with holes to accommodate screws used in mounting the transformer in the receiver.

Usage: As a coupling device in a low-frequency amplifier.

Outstanding features: Strong construction. Terminals conveniently located. Entirely enclosed in metal case. Fine reproducing qualities.

Maker: Dongan Electric Mfg. Co.



An Instrument That Puts New Life Into Old Vacuum Valves

Name of instrument: Tube reviver.

Description: This is a simply made device, which may be screwed into any alternating-current lamp socket. It consists of a suitable resistance inclosed in a ventilated case to prevent undue heating. On one side of this case is mounted the plug which screws into a lamp socket and on the other side is a receptacle into which any vacuum valve of the UX-201-a type may be inserted for rejuvenation. Means are provided for supplying two different voltages to the filament of the valve, as is required in any satisfactory rejuvenation process.

Usage: UX-201-a type valves which have decreased filament emission due to old age or the use of excessive voltage on the filaments may be brought back to normal in a few minutes through the use of this device.

Outstanding features: Simple and sturdy in construction. Easy to use. Effective in action.

Maker: International Resistance Co.

A Device That Protects the Reproducer Unit by Filtering Out the High DC Current

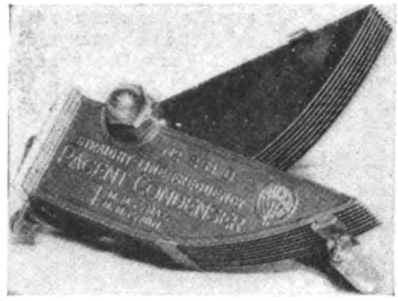
Name of instrument: Tone filter.

Description: This unit is enclosed in a neat metal case with a composition insert at one end which carries the four terminals of the instrument. The unit consists of an inductance and a by-pass condenser so connected that when this device is connected between the receiver output and the reproducer the direct current passes through the inductance while the alternating current (which is the only useful part of the plate current so far as the reproducer is concerned) passes through the reproducer winding and actuates the reproducing mechanism. The terminals on this tone filter consist of four "phone tip" jacks, and a connecting cord provided with phone tip terminals is supplied with the instrument.

Usage: As a filter to keep the high current required in the plate circuits of power valves out of the windings of the reproducer. This not only protects the reproducer from excessively high current flow, but improves the quality of reproduction because of the elimination of the constant DC strain which would otherwise be present in the windings of the reproducer.

Outstanding features: Easily connected between reproducer and receiver. Provides ample protection for the reproducer where the DC current flow in the plate circuit of the power amplifier valve is not in excess of 35 milliamperes. Neat in appearance. Compact in size.

Maker: National Company, Inc.



A Variable Condenser That Saves Space Behind the Panel

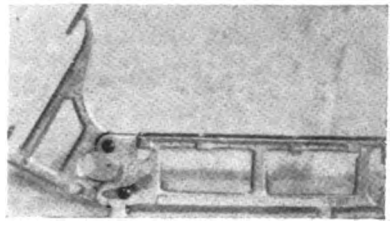
Name of instrument: Variable condenser.

Description: This variable condenser is a precision instrument of highly efficient design. The spacing between plates is extremely small, with the result that the entire device projects only about one inch behind the panel. Isolantite is used as the insulating material. As a result, the dielectric losses are kept to a minimum. The tuning characteristics of this condenser are of the straight-line-frequency type; all plates are rigidly secured in position and a positive contact with the rotor section is constantly maintained.

Usage: As a tuning device in a radio circuit or for any use that requires a highly efficient variable capacity unit.

Outstanding features: Compact size. High efficiency. High-quality design and construction which mean the indefinite maintenance of high efficiency.

Maker: Pacent Electric Co., Inc.



A Solid Foundation for Mounting Panels and Sub-panels

Name of instrument: Mounting bracket.

Description: This bracket is so designed that two of them furnish a solid foundation for a home-constructed receiver. The device is provided with the necessary screw holes for mounting the brackets on the base of the cabinet, if so desired, and for mounting the sub-panel, the main panel and the binding post panel on the bracket. The bracket is adjustable so that it will support the front panel of the receiver at any desired angle.

Usage: As a foundation for the assembly of any receiver. Two of these brackets are used in the average receiver, one at either end. The front panel, the sub-panel and the terminal strip may all be mounted directly on the brackets.

Outstanding features: Provides a rigid framework for the receiver assembly. Adjustable to permit mounting the front panel at any desired angle.

Maker: Bruno Radio Corp.

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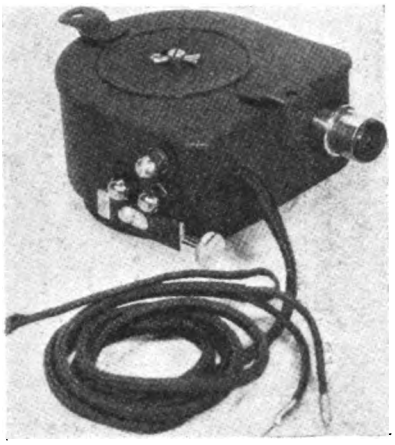


A Handy Extension Cord for Reproducers

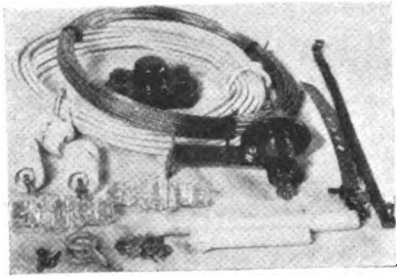
Name of instrument: Cuno "Reel" loud-speaker extension cord, Model No. 687.

Description: This device consists of a 25-foot extension cord for use when it is desired to place a reproducer at some distance from the receiver. Its special value lies in the fact that the unused portion of the extension cord remains on a reel, which is inclosed in a metal case that is intended to be screwed on to the outside of the receiver cabinet. This reel makes use of a spring arrangement, which permits the extension cord to be pulled out to any length desired. But, when the extension is no longer required, it is only necessary to press a button on the case of the instrument and the extension cord will be wound on the reel by the spring arrangement mentioned above and with no effort on the part of the user. This device is equipped with a second cord to be connected to the receiver where the reproducer would ordinarily be connected.

Usage: To permit the use of a reproducer at a point distant from the receiver.

Outstanding features: This unit automatically reels in any slack in the extension wire and therefore eliminates the loose, straggly appearance of the ordinary extension cord. Can be reeled up out of the way by simply pressing a button on the case.

Maker: Cuno Engineering Corp.



This Kit Simplifies Antenna Installation

Name of instrument: Antenna kit.

Description: This kit consists of a 100-foot coil of 7-strand, hard-drawn, copper wire, 50 feet of insulated lead-in wire, a lightning arrestor, two glass insulators, one window lead-in strip, one ground clamp, three porcelain wall insulators, two porcelain lead-in bushings and the necessary screw eyes, staples, etc. All of this material is high grade.

Usage: Complete equipment for the installation of an outdoor antenna.

Outstanding features: High-grade material throughout. Most complete. Provides all the items needed for erecting an outdoor antenna.

Maker: M. M. Fleron & Son, Inc.

An "All Purpose" Variable Resistor

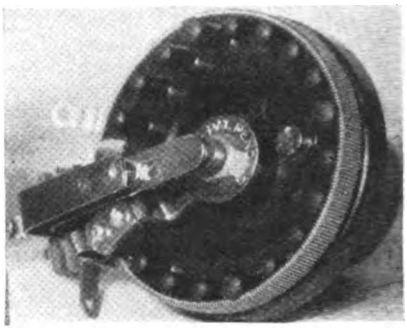
Name of instrument: Resistograd.

Description: This is a non-inductive resistance, the value of which may be varied approximately from zero to 30,000,000 ohms by means of the knob provided with the instrument. A special compound is hermetically sealed into the holding compartment. The resistance of this compound is varied according to the degree of contact obtained by turning the shaft.

Usage: As a variable grid-leak or for other purposes where a variable high-resistance unit is required.

Outstanding features: Neat appearance. Hermetically sealed with resistance material. Single-hole mounting. Equipped with control knob.

Maker: Pilot Electric Mfg. Co.



A Rheostat That Eliminates the Battery Switch

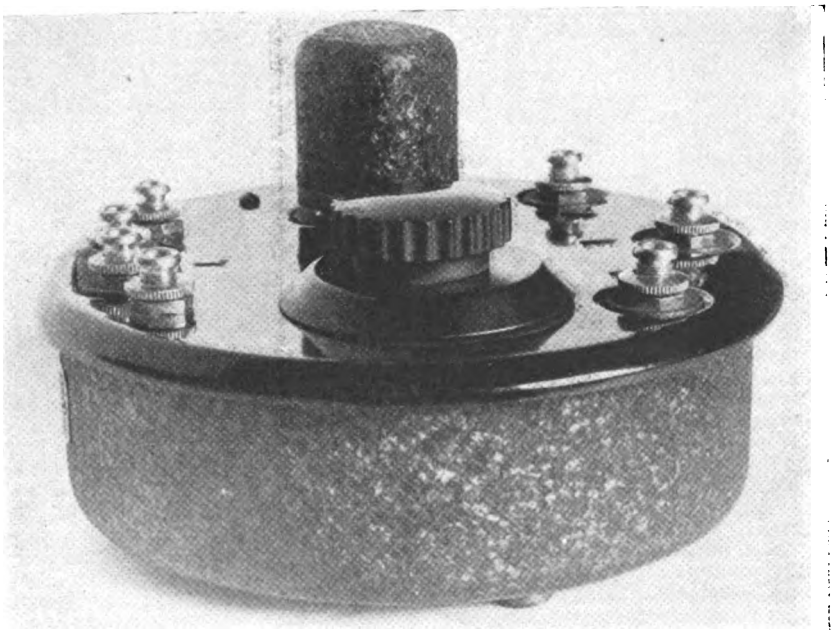
Name of instrument: Combination rheostat and battery switch.

Description: This rheostat may be obtained in various resistances to meet individual requirements. The wire-wound resistance element is carefully made with a large number of small turns which provide an extremely gradual variation of resistance. The resistance unit is clamped around a series of posts on the composition base of the instrument and is practically air-supported. This provision allows good radiation of any heat developed. The battery-switch feature is so arranged that when the rheostat is turned to the "off" position, the "A" battery circuit is broken and all the vacuum valves in the receiver are turned off, regardless of whether they all work through this rheostat or not.

Usage: In any radio receiver, for the control of the filament current to one or more vacuum tubes, and at the same time to serve as a battery switch for all of the vacuum valves.

Outstanding features: Air-cooled. Practically a vernier control of resistance. Single-hole mounting. Eliminates necessity for a separate battery switch.

Maker: Yaxley Manufacturing Company.



A "Shielded" Crystal Receiver

A metal panel and container completely inclose this new and popular German crystal set; even the crystal detector is hidden under a metal cap. Tuning is effected by means of a small variometer which is connected in series with a fixed antenna coil.

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A Seven-tube Single-Control Receiver with Built-in Loop and Speaker

Name of instrument: The Rauland "Sovereign" Receiver.

Usage: For reception of broadcast programs.

Outstanding features: Single-control tuning. Equipped with reproducer and directional loop antenna, both of which are concealed within the cabinet. Space provided for batteries or power-packs within the cabinet. Requires no external equipment or wires. High selectivity. Luxurious appearance.

Description: The Rauland "Sovereign"* receiver consists of the standard Rauland seven-tube chassis mounted in a high-boy console.

The "Sovereign" model receiver is a beautiful piece of furniture. This cabinet is of the Spanish Renaissance period and is finished in brown, crackle parchment; the underlying field is of gold, but so little of this shows through the crackle finish that the composite tone is a decided brown.

A good idea of the design of the cabinet may be obtained from the accompanying illustration. It is five feet in height, 40 inches wide and 19 inches deep; the six-leg base is of solid walnut and is also finished in brown, but is highlighted in bronze.

Access to the compartments for installing the batteries, or the power-supply unit, as well as to the receiver, for installing the vacuum valves, is gained through a hinged portion of the rear wall of the cabinet.

The reproducer and loop are located in the upper half of the cabinet. The former is placed directly behind a grill which is in the exact center of this upper section. Just below this grill is a knob by means of which the loop may be turned to take full advantage of its directional properties.

In the center of the lower section of the cabinet is the control panel of the receiver unit. This panel is of metal and carries two adjustment knobs, the "on-off" switch, and a small window behind which the calibrated tuning scale is visible. This scale is calibrated in both degrees and in wavelengths and is illuminated from within by a pilot light which lights automatically when the receiver battery switch is turned "on." The control and operation of the receiver is extremely simple. The wavelength tuning is accomplished entirely by means of the larger of the two adjustment knobs without any auxiliary controls or adjustments of any kind.

The other adjustment knob is the volume control; this permits the volume to be cut down to just the proper degree for most pleasing reproduction.

The use of the directional control knob is not required in the case of reception from local broadcasting stations, but it does help materially in the reception of weak signals from more distant stations. When an outdoor or indoor antenna is used in conjunction with a ground connection, this directional control knob is not used.

The "on-off" switch not only turns the "A" battery current on and off, but it also operates a relay inside of the cabinet. This relay switch in turn controls the current supply from the house-lighting lines to the "A" battery trickle charger and to the "B" power-pack if one of these units is used in place of "B" batteries.

For readers interested in semi-technicalities it may be noted that the receiver consists of three stages of tuned high-frequency amplification, a vacuum valve detector and three stages of low-frequency amplification. Transformer coupling is used in the input to the first low-frequency stage and the input coupling to the second and third stages is done by means of impedence coupling.

The three variable condensers that tune the three high-frequency stages, and the variable condenser that tunes the antenna circuit, are all coupled together to operate from the single tuning control. In order to make possible the simultaneous tuning of four circuits, it is essential that the coils and tuning condensers be carefully matched; when the receiver leaves the factory it is exactly in adjustment and requires no further adjustment of any kind on the part of the ultimate purchaser of the receiver.

Each of the coils used in the high-frequency amplifier is individually shielded to prevent external pick-up and to eliminate interaction and feedback between stages. The precautions taken in this direction have been ample to provide the operator of the receiver an absolute control over oscillation, by means of the volume control.

The receiver is assembled on a heavy frame; a composition sub-panel is provided for mounting the parts which require a high degree of insulation. The front panel is spot-welded to the metal frame for greater security. The result of this strong construction is that the assembly is rigid—an essential feature where permanency of alignment is an important factor.

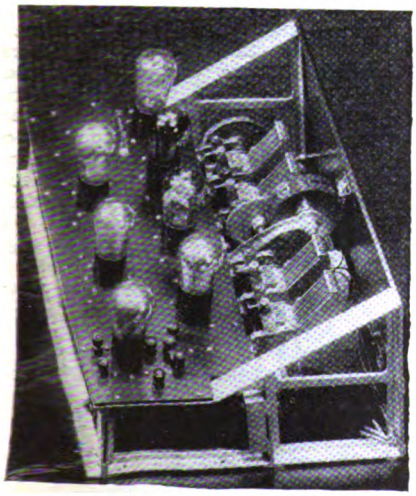
In tests on this receiver maximum results were obtained with the use of

*The name "Sovereign" applies to this console cabinet rather than to the receiver chassis because the same chassis is used in two other models: the "Lorraine" which is also a high-boy console model, but lower in price; and the "Forte" which is a table-mounting model of the treasure-chest type, and is lower in price than the other two models.

From a photograph made for POPULAR RADIO

A SELF-CONTAINED SINGLE-CONTROL RECEIVER

The loudspeaker is concealed in the upper part of the cabinet behind a grilled opening; the loop antenna is also installed inside of the console and is controlled by a knob on the panel.



An inside view of the receiver chassis showing the method of ganging the four tuning condensers.

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From a photograph made for POPULAR RADIO

A New Radio "Time-Clock"

This novel device for turning your set "on" or "off" automatically may also be set to give a time signal in the loudspeaker to remind the listener of an appointment or a feature program. The device may also be adapted to turn a phonograph "on" or "off" or to regulate an oil-burning furnace. It was developed by Ushichiro Tokumi, a Japanese radio engineer.

an outdoor antenna of from 60 to 100 feet in length, including the lead-in wire. Good results, however, may be obtained with an antenna strung around the picture moulding of the room in which the receiver is located. For those who prefer to eliminate the antenna entirely, or in locations where interference between stations is particularly bad, the loop antenna solves the problem. This arrangement will provide plenty of "pick-up" on all local reception and many out of town stations.

A striking example of the selectivity of the set was found in the experience of the author while using one of these receivers in his hotel room during a visit to Chicago. It happened that there was a thousand-watt broadcasting station on the roof of the hotel which was in operation most of the afternoon and half of the evening. The antenna of this station was directly overhead and probably not more than 150 feet above the receiver. In spite of these conditions, and while this station was in operation, no difficulty was encountered in tuning in any of the other stations in and around Chicago, without interference from the station overhead.

The manufacturer of this receiver also manufactures the "Constant-B Battery Eliminator," a unit well adapted for use with this receiver in place of the usual "B" batteries. This unit supplies the four "B" voltages required in the operation of the receiver, and operates from the alternating current, house-lighting lines. A switch is provided by means of which the maximum voltage to the receiver may be limited to approximately 135 volts where the UX-112 type power valve is used. Or, if it is desired to use a UX-171 type power valve, the switch may be thrown to the "high" side and the eliminator unit will then supply a maximum of around 180 volts.

If an AC light line is not available, the receiver will, of course, work just as satisfactorily with "B" batteries. When batteries are used, the UX-112 type power valve will be found best for use in the last low-frequency stage —at least from the standpoint of battery economy.

A storage "A" battery and trickle charger is recommended for the filament supply source.

The "C" battery should be of the small dry-cell type.

The tone quality of this receiver is decidedly good and a high degree of undistorted volume can be obtained on local and semi-distant stations.

Maker: All-American Radio Corporation.

A New Loudspeaker Extension Cord

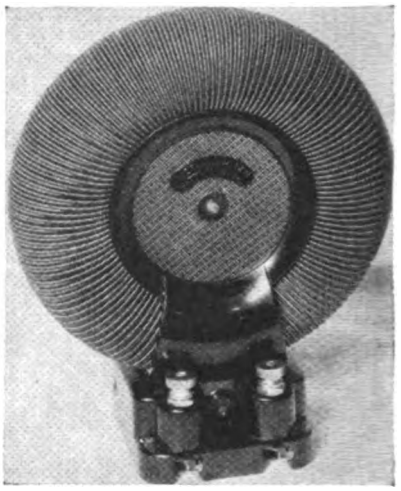
Name of instrument: Extension cord for reproducers.

Description: This is a two-conductor cord with a woven cover; it is equipped with a double-spring connector, by means of which the extension cord is connected to the cord on the reproducer. The ends of this cord terminate in standard phone tips. In order to connect the extension cord into the reproducer circuit it is only necessary to insert one pair of these tips into the spring connector, which is provided with the cord, and the tips of the reproducer cord into the other end of this connection. The free end of the extension cord is then connected to the receiver.

Usage: In connection with any reproducer when it is desired to place it at some distance from the receiver.

Outstanding features: Well made. Easy to install. Neat appearance.

Maker: Birnbach Radio Co.



An Interchangeable Coil for All-Wave Receivers

Name of instrument: Interchangeable toroid coil and base.

Description: These coils and mountings are an extremely workmanlike product of a European manufacturer. The coils are of silk-covered wire, wound in toroid form with no dielectric material whatsoever inside of the winding. The toroid is mounted on a composition center which is made in two parts so that when the parts are fastened together the coil is firmly clamped in place. An extension of this composition center-clamp also serves as the terminal plug. The four terminals make firm contact with corresponding terminals in the coil socket which is mounted in the receiver in much the same manner as a vacuum-valve socket, and has four binding posts for making connections to the other parts of the set. The coils are inserted in these sockets in the same manner that a vacuum tube is inserted in its socket. The coils are made in two sizes; the smaller covers a waveband of from 150 to 600 meters with a .0005 mfd. variable condenser. The larger coils cover the waveband from 600 to 2,100 meters with a similar tuning condenser. It is the work of a moment to change the receiver over from one with a maximum of 600 meters to one with a maximum of 2,100 meters.

Usage: A receiver which is equipped with these coils and coil sockets becomes a highly efficient receiver with a wavelength range from 150 to 2,100 meters.

Outstanding features: Substantial air-core windings. Extremely neat in workmanship and appearance. Highly efficient. Change over from one waveband to another is only a matter of seconds.

Maker: A. B. Stern and Stern, Stockholm, Sweden.

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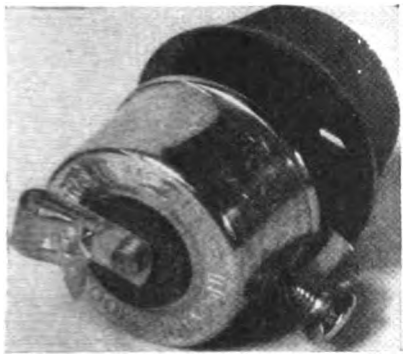


A Variable High Resistance That Carries High Currents

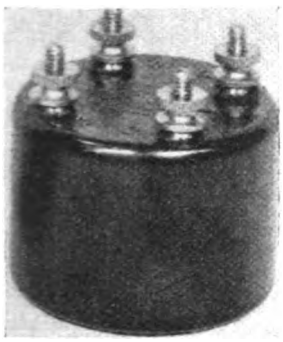
Name of instrument: Clarostat.

Description: This unit provides a resistance, continuously variable from zero to 5,000,000 ohms. This great range is accomplished by four complete turns of the knob which is attached to the unit. Except for the composition knob, the unit is completely inclosed in a drawn metal case with an insulated bushing for one of the terminals. The knob operates a plunger arrangement which varies the pressure on the resistive material contained in the unit, and in so doing varies the resistance of the instrument. One complete turn of the knob varies the resistance only from 0 to 500 ohms, thus giving accurate adjustment for any resistance within this range. A second revolution varies it from 500 to approximately 6,000 ohms, thus giving a sufficiently close adjustment anywhere within this range. The third and fourth revolutions of the knob provide a gradual increase of resistance from 6,000 ohms up to maximum.

Usage: As the voltage regulators in a "B" power-pack, as a volume control in the plate circuit of a receiver, or for any purpose which requires a variable resistance of this type.

Outstanding features: Smooth adjustment. Stable operation. Carries up to 20 watts of current. Single-hole panel mounting. Good mechanical design.

Maker: American Mechanical Laboratories, Inc.



A Long-Wave Transformer That Will Reduce Oscillation

Name of instrument: Long-wave, air-core transformer.

Description: This air-core transformer is compact and completely inclosed in an insulated case. The design of the coils is such that there is no necessity for shielding the receiver in which these transformers are used and the units may be placed close together without dangerous interaction between stages. Each transformer is equipped with four binding-post terminals at the top of the case, and these terminals are arranged in an order that makes all leads as short as possible. The transformers are supplied in sets of four and the individual units are numbered from one to four to indicate their position in the receiver circuit.

Usage: As the coupling units in the intermediate-frequency amplifier of a superheterodyne receiver.

Outstanding features: Compact size. Convenient arrangement of connection terminals. Eliminate oscillation in the intermediate amplifier. Reduce "repeat points." Efficient coupling units for intermediate frequency amplifiers.

Maker: Lincoln Quality Products Co.

A Power-Pack Filter Condenser That Will Stand Up Under 400 Volts

Name of instrument: "B" block condenser unit.

Description: This condenser block includes five different condensers of capacities ranging from 1 mfd. up to 8 mfds. It is especially designed for use in "B" power-packs where the working voltage is not higher than 400 volts. This includes all power-packs which use either the gaseous or the filament type of rectifier valves. The capacities are correct for the standard "B" power-pack circuits. One side of each of the condensers is connected to a common terminal on the terminal panel. The other side of each condenser is brought out to an individual terminal. The complete unit is inclosed in a metal case.

Usage: To provide the high capacities required in the filter circuit of a "B" power-pack.

Outstanding features: Provides a desirable range of capacity values. Neat in appearance. Capacity values of the component condensers clearly marked on the terminal panel. The voltage rating allows a good factor of safety when used in the ordinary power-pack.

Maker: National Company, Inc.

A New Receiver of Remarkable Selectivity

Name of instrument: Elkay "Senior Six" Receiver.

Usage: For the reception of radio broadcasting.

Outstanding features: Remarkable selectivity. Excellent tone quality utilizing Truphonic low-frequency amplification. Complete shielding. Designed to use any make of vacuum valves. Neat appearance. Easy to tune.

Description: The outstanding features of the Elkay receiver are its great selectivity and sensitivity. Both of these characteristics are decidedly advantageous in view of the large number of broadcasting stations "on the air."

In making tests on this receiver, it was put into operation in a location where considerable trouble has been encountered due to the opening up of a new high-power station. When this station is in operation it has been found practically impossible, with the average receiver, to tune in any other stations within 20 meters of the operating wavelength of this new local station, without hearing the local program in the background.

Under these conditions it was a considerable surprise to find that the Elkay receiver was able to tune in, without any interference, stations within ten meters of this local station, as well as one station only six meters away. And this was accomplished while using an antenna slightly over 100 feet in length—long enough to make the tuning of the average receiver hopelessly broad.

If this receiver made use of four, or even of three, stages of tuned-high-frequency amplification this performance would not have been so remarkable; but it contains only two stages of high-frequency amplification. Moreover, apparently no sacrifice of volume, of sensitivity or tone quality

(*Continued on page 396*)

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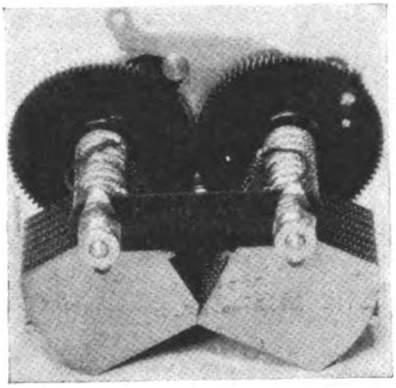
Herbert

A BUTTERFLY-PANELLED RECEIVING SET

Glass backed with real butterflies and pressed flowers and Chinese silk forms the panel of this four-tube single-control regenerative receiver. Both the set and the panel were made and designed by Wei Yoh Wu, a Chinese electrical engineer, in his laboratory at Astoria, New York.



This Variable Condenser Eliminates Hand Capacity

Name of instrument: Variable condenser.

Description: The construction of this instrument is unique in that instead of having one set of movable plates that intermesh with a set of stationary plates, both sets of plates are movable. The plates are rectangular in shape and, as a result, the condenser measures only 3½ inches across when the plates are entirely unmeshed. The plates are operated by a single shaft which is geared to the plates through gears of insulating material. In addition to providing mechanical coupling, these gears insulate the shaft from the plates so that the shaft is electrically isolated from the "live" parts of the circuit and hand-capacity effect is therefore eliminated. Mechanical means are provided to make a straight-line-frequency tuning characteristic in the circuit in which this instrument is employed.

Usage: As a tuning element in any high-frequency circuit, or for any other use where a variable capacity unit is required.

Outstanding features: Eliminates body capacity. Provides straight-line-frequency tuning. Occupies little space behind the panel. Provides positive contacts through the use of pig-tail connections to moving plate sections. Eliminates the necessity for vernier dial in many cases, as a full 360 degree movement of the dial is used to vary the capacity of this unit from minimum to maximum.

Maker: Gray and Danielson Mfg. Co. (Remler Radio Mfg. Co.)

This Unit Simplifies the Construction of Power-Packs

Name of instrument: Power compact.

Description: This unit combines a power transformer, buffer condensers and filter chokes, all inclosed in a single metal case. Terminals are provided for connecting this unit to the other parts needed to make up a power-pack capable of supplying all necessary "B" voltages to a receiver, including the high voltage required by a UX-171 type power amplifier valve. The unit is designed for use with a ratheon rectifier valve. It is equipped with an extension cord and plug for plugging into the AC light socket.

Usage: Combines the power transformer, buffer condensers and chokes in a single compact unit, for use in a power-pack to supply "B" and "C" voltages to a receiver which makes use of a UX-171 type power valve in the last low-frequency stage. The unit is also equipped to supply the filament voltage for the operation of the power valve.

Outstanding features: Compact size. Solid construction. Simplifies construction and wiring of a power-pack. Provides filament voltage for a half-ampere power tube.

Maker: Thordarson Electric Mfg. Co.

A Compact Receiver in a "Drawer" Cabinet

Name of instrument: Magnavox Radio Receiver, Model T.

Usage: For radio broadcast reception.

Outstanding features: Absolute single-control tuning. Unusually compact. Neat appearance. Good tone quality. Novel external design. Excellent selectivity and good distance reception. Equipped with battery cable and plug.

Description: One of the most striking features of this new set lies in its novel design. Instead of mounting the set in a cabinet which opens at the top, this receiver has been assembled in a wooden drawer which slides in and out of the cabinet.

This cabinet is of mahogany, finished in a quiet, two-tone effect of dark brown, with the front of the receiver drawer finished to match.

Another feature of the receiver is the simplicity of panel design. On it are mounted three knobs: A large one in the center which accomplishes *all* of the tuning of the receiver; a smaller knob to the right which provides a control for sensitivity and volume; and a third knob to the left to turn the receiver "on" and "off."

Just above the large wavelength tuning control is a window behind which a calibrated scale revolves; this shows the wavelength to which the receiver is tuned. The fact that this scale is calibrated in wavelengths simplifies the tuning of the receiver to a surprising degree.

The circuit employs five vacuum valves (tubes) and consists of two stages of tuned, high-frequency (radio-frequency) amplification, detector and two stages of transformer-coupled, low-frequency (audio-frequency) amplification. The coupled antenna circuit and the two stages of high-frequency amplification are tuned by variable condensers with their rotor plates mounted on a common control shaft. This shaft is operated by the large tuning control

(*Continued on page 398*)

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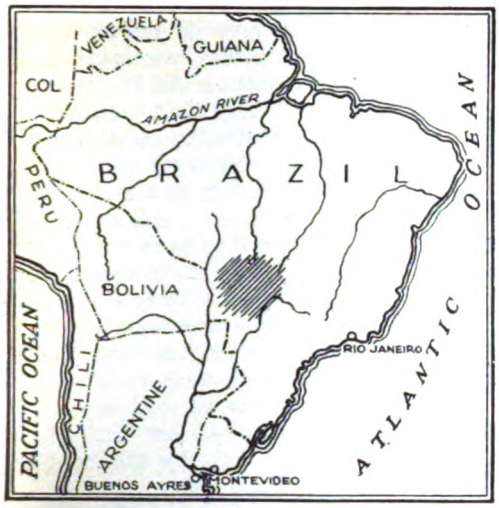
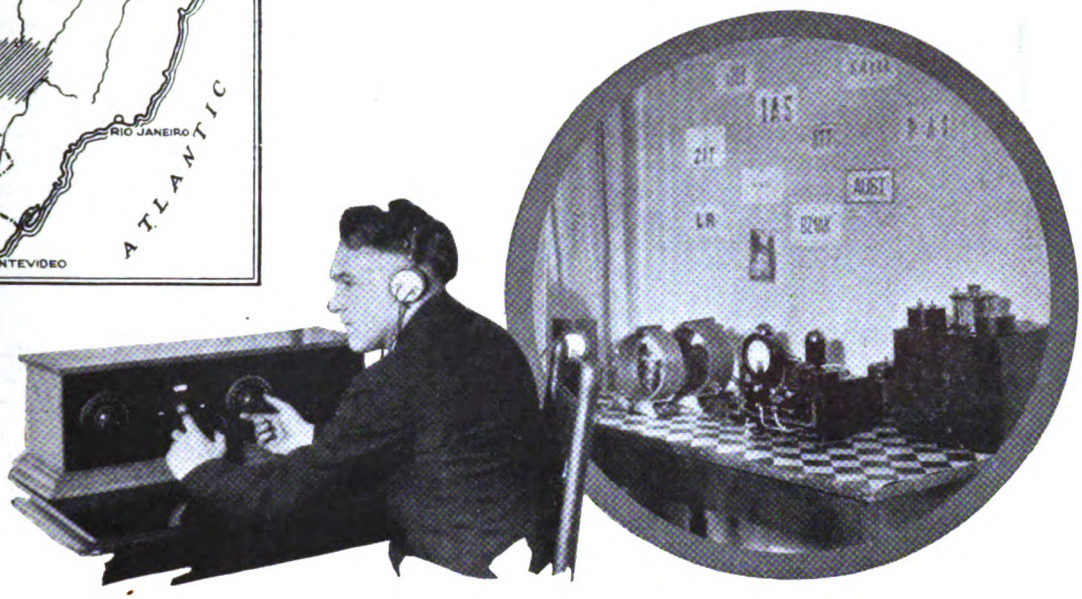
"Buzzing" with Bussey in Brazil

By RALPH E. THOMAS (2-UK)



From the "River of Doubt" to New Jersey

Ralph Thomas, a radio amateur of New Brunswick, N. J., is one of the fortunate few to pick up code signals from the Dyott expedition in South America; the shaded portion of the above map shows the location of the explorers.



Nearly any "ham" would give his best 50-watter to pick up the magic letters "GMD," the call letters of the George Miller Dyott expedition now exploring the wilderness of Brazil. The expedition is trying to proceed across the central plateau of Brazil and the Parecis Hills to explore the headwaters of the Rio Roosevelt, better known as the "River of Doubt." Station GMD, operated by Eugene Bussey of Yonkers, New York, and transmitting on wavelengths between 20 and 80 meters, has kept the expedition almost constantly in touch with civilization; the expedition also carries a small portable set, 2-GYA, which relays messages through GMD from the more inaccessible regions.

SLOWLY the dials of the short-wave tuner swung around as I tuned in for long distance at Amateur Station 2-UK. Signals were coming in from all parts of the globe. Some of the signals were strong, clear and steady; others were faint, fading and scarcely readable.

But one fact was certain—this was a good night for "DX" reception.

Finally the dials ceased turning, for as the set was brought into resonance I heard the signals of British 2-NM calling "test U. S. A."

A twist of the throw-over switch and my transmitter was ready for action; within a few minutes communication was established and a friendly chat ensued. In the same manner Portugal 1-AE, Mexican 5-B and several others were worked. All reported my signals "fine business."

Feeling well satisfied with results so far, I turned to the lower end of the band and logged several Brazilian stations. One after another, Brazilian 1-AW, 1-IB, 1-AK and 5-AB were tuned in. But who was that faint, steady signal that was barely audible through the "Qrm" and occasional crashes of static, calling "cq, cq, de GMD, GMD, GMD."

Once more my transmitter was brought into play and my signals flashed out into space, calling "GMD, GMD, de 2-UK, 2-UK."

There was a moment of suspense as I switched back to my receiver. Would GMD hear my signals and reply?

Sure enough, the faint signals this time could be heard calling 2-UK; communication had been established.

"This is G. M. Dyott Expedition, in the wilderness of Brazil," said Bussey, the radio operator. "I am certainly glad to connect, as you are the first station to answer me for a long time. I have a long message for the New York *Times*; will you relay it for me?"

The interference at this point became so great that I was compelled to ask him to raise his wave. This he did, and after more or less difficulty all the traffic was cleared and the conversation took a general trend, and we chatted for several minutes. The message was as follows:

G. M. Dyott Expedition,
Brazil, Oct. 18, 1926.

New York *Times*,
New York:

Expedition now encamped on the banks of the Sepotuba, preparing for canoe transportation up river. Limited facilities necessitate decrease in baggage and personnel. Perkins returning.

(Signed) G. M. Dyott.

"I am using a portable set with less than twenty watts input," continued Bussey. "Your signals are clear, steady and very strong. What is the nature of your set and what power are you using?"

I gave him the information. My transmitter consists of a 50-watt tube in the Hartley circuit. The high voltage is supplied by an Acme 600-watt power transformer which transforms the 110-volt, 60-cycle house current to 1500 volts, which in turn is rectified by Rectigon tubes working on each half of the cycle. The inductances are sections of a Radio Corporation helix; the condensers are Dubilier. The radiating system consists of a vertical antenna 30 feet long and a horizontal counterpoise of about the same length, twelve feet from the ground. This is worked on the fundamental wavelength of thirty-seven and one-half meters, and is what is known as a current feed system. The receiver is a home-made affair built along low-loss lines and uses one step of audio frequency.

(*Continued on page 391*)

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IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

Messages by "Invisible Light"

THE famous "black light," better called invisible light, continues to play an important rôle in the day's news. As was mentioned recently in this department, Mr. J. L. Baird, now to the fore in England as an inventor of television apparatus, has used the invisible rays of infra-red, not only to operate his television machine but also to carry messages across the lecture platform. More recently, Dr. Donald C. Stockbarger, of the Massachusetts Institute of Technology, attracted much attention by delivering a lecture in Boston on the use of the invisible rays of ultraviolet light in producing various physical effects and, once more, in transmitting telegraphic and other messages across the lecture platform.

Although there is nothing scientifically new in these experiments (both the infra-red rays and the ultraviolet rays having been demonstrated by the famous English physicist, John Tyndall, more than a generation ago), the recent recrudescence of public attention to these matters is another sign of the lively interest in science which radio has done so much to foster.

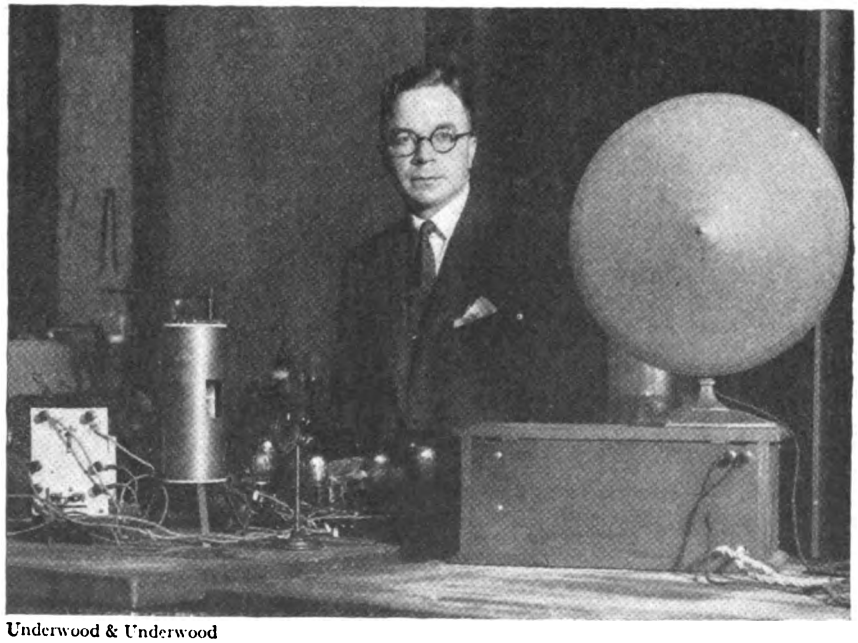
The term "black light" is a misnomer. Anything which is "black" is something which absorbs the radiation which falls on it, so that no radiant energy (at least within the visible range) is reflected from it. What Mr. Baird and Dr. Stockbarger really use is *invisible light*. As explained many times in POPULAR RADIO, the spectrum of radiant energy begins at the long-wave end with the waves of radio and extends continuously to the shortest waves which constitute the gamma rays of radium and the cosmic rays newly investigated by Dr. Werner Kolhoerster and Professor R. A. Millikan. A very short portion of this range of wavelengths constitutes what we call light, which means merely the wavelengths visible to the human eye. Exactly similar to these light waves but slightly longer than them are the infra-red waves. These are invisible. At the other end of the visible spectrum lie the equally invisible ultraviolet rays which are slightly shorter than those of visible light. Either of these varieties of invisible light may be used as beams to carry messages, as has been demonstrated many times by General Ferrié, Dr. Coblentz and others.

That either of the invisible rays will ever serve as an important rival to radio in the business of carrying messages through the ether is unlikely. For one thing, it is quite difficult to procure intense beams of either infra-red rays or of ultraviolet rays. The infra-red rays are emitted by any hot body, for example, by the heated wires of the modern household electric radiators. The ultraviolet rays are emitted by electric arcs, especially by the mercury arc used in the Cooper-Hewitt lamp. The usual practical source of ultraviolet is this Cooper-Hewitt arc contained in a quartz tube instead of a glass tube. Quartz is used because it is transparent to the ultraviolet rays whereas glass is opaque.

There is a difficulty, however, due to the fact that both the electric radiator (serving as a source of infra-red radiation) and the mercury arc which emits ultraviolet, also emit large amounts of ordinary visible light. To procure invisible beams of either form of rays it is necessary to filter out the visible light in some fashion. Up to the present this has proved quite difficult to do, as nearly all of the kinds of glass and other substances which transmit the invisible rays also transmit at least a portion of the visible ones. On the other hand, if the filtering substance is made sufficiently thick to hold back all of the visible radiation it also diminishes substantially the intensity of the invisible rays which it is desired to transmit.

What is needed in the present-day technique of using invisible radiation is what the radio engineer would call a band-pass filter, some device which will transmit, undiminished, the energy contained in frequencies corresponding to the wavelengths of the infra-red or of the ultraviolet, while absorbing and retaining the wavelengths on either side of this range.

The analogy with radio goes even deeper. Just as the band-pass filters now developed for either radio frequencies or



Underwood & Underwood

THE RAYS OF "BLACK LIGHT" PERFORM FOR HIM

Dr. Donald C. Stockbarger, of the Massachusetts Institute of Technology, recently demonstrated some of the remarkable properties of the rays of "black light," more properly called "invisible light." These rays are ether waves just a little longer or shorter than light rays.

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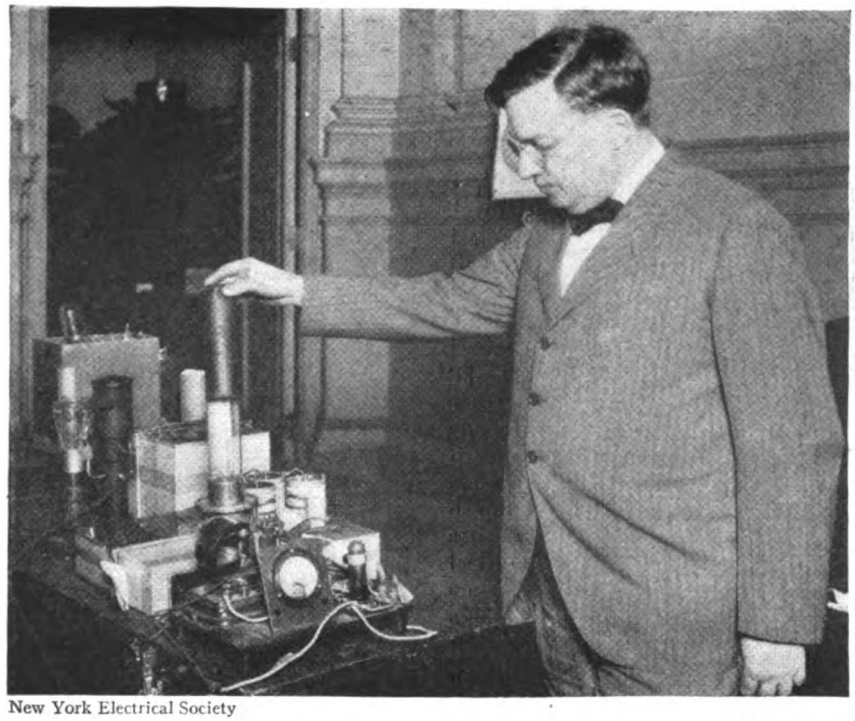
audio frequencies procure their absorption by means of internal resonant circuits, so the atoms and electrons of substances operate, it is imagined, in resonance with the impinging rays, so that these rays are absorbed or transmitted just as the atomic resonances may determine.

Unfortunately, we still know much less about the theory of these atomic and electronic resonances than we do about the theory of band-pass filters. Perhaps when we understand these matters better we will be able to make more powerful beams of the invisible radiation, entirely free from visible light and, therefore, completely invisible.

Speedy Photoelectric Cells

A RECENT paper by Dr. F. E. Null, of the department of physics of the University of Illinois, begins with a sentence which is worth quoting. "The problem of photoelectric emission," Dr. Null writes, "is one of the most fundamental in physics but our knowledge of the subject is limited to a few simple laws."* The importance and behavior of the fundamental instrument of photoelectric emission, the photoelectric cell, was described in POPULAR RADIO some time ago by the Editor of this Department. Essentially it is a device by which an entering light ray falls upon a plate of sensitive metal and causes the emission from this metal of a stream of electrons. These electrons are precisely similar to those emitted by the filament of the usual radio vacuum tube, the latter device being one in which the emission of the electrons is due to the heating of the filament rather than to light supplied from outside.



New York Electrical Society

PHOTOELECTRICITY AND RADIO MAKE A NOVEL BURGLAR ALARM

The upright glass tube touched by the experimenter's hand is a photoelectric cell. When the shadow of an intruder falls on this cell the electric signal produced by the shadow is magnified by a radio amplifier and rings a bell.

Photoelectric cells have been much used in various light-detecting and light-measuring devices as well as in practical inventions for turning street lights on or off, for operating burglar alarms and many others. As Dr. Null implies, our knowledge of the true inwardness of photoelectric emission is now one of the most distressing low points in scientific information. Readers of this Department are already familiar with the present uncertainty concerning the nature of radiation; some facts indicating that light and other forms of radiation (including radio) are composed of waves, while other facts indicate that these radiations are composed of the tiny particles which have been christened quanta.

Many experimenters have suspected that a more searching study of photoelectric emission might resolve this controversy. Dr. Null agrees. By means of ingenious arrangements of his electric circuits he has been able to study the action of very short pulses of light affecting photoelectric cells. There is theoretical possibility that if the pulse of entering light is short enough; so that it includes only a limited number of waves or, if the other theory is preferred, a limited number of quanta; the action of the photoelectric cell might yield facts distinguishing definitely between the two theories.

Dr. Null's results have not yet reached

(*Continued on page 400*)

New York Electrical Society

HOW RADIO DEVICES ARE USED TO AID THE PHOTOELECTRIC ORGAN

This new device plays tunes from light rays. Beams of light from small lamps pass through the holes in the rotating disk to fall on a photoelectric cell twenty-five feet away. This produces an electric current which a loudspeaker converts into a tone.

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★ PROGRAM FEATURES *for* THE MONTH

Here is POPULAR RADIO'S *selection of the "star" broadcast features for the month beginning March 20—program numbers of outstanding merit that are selected on the basis of intrinsic worth, as well as upon their importance as determined by the large audiences reached by powerful single stations and by the chain stations that now cover the country. Every radio fan has—or should have—a receiver good enough to tune in on most of the features that are listed.*

(*Eastern Standard Time*)

March 20

BEDFORD Y.M.C.A. MEN'S CONFERENCE; 4.00 P. M.; *Dr. S. Parkes Cadman;* WEAF, WEEI, WCSH, WTAG, WCAE, WSAI.

CROSLEY RADIO FEATURE; 5.30 P. M.; *varied program*; WEAF, WEEI, WJAR, WTAG, WGN, WFI, WRC, WCSH, WCAE, WTAM, WWJ, WSAI, KSD, WDAF, WHAS, WSM, WSB, WMC, WGY.

THE CAPITOL GRAND ORCHESTRA (and Major Bowes' family); 7.20 P. M.; *symphonic music and soloists;* WEAF, WEEI, KSD, WRC, WWJ, WJAR, WCAE, WTAG.

The first part of this program, which includes the selections played by the full orchestra of seventy pieces, is broadcast direct from the stage of the Capitol Theatre, N. Y.; the latter part, that includes the soloists and small ensemble, is broadcast from the studio beneath the stage. The musical director is "Dr." Billy Axt—who has been playing solos, composing music and supervising the musical programs since "Roxie" first had charge of the Capitol in 1922. Dr. Billy's degree was obtained in Germany.

COOK'S TOURS; 8.30 P. M.; *talk and music;* WJZ.

A unique entertainment made up of a travelogue, delivered by a lecturer who has visited the spot described; interspersed with the folk and national music of the country and provinces treated.

ATWATER KENT HOUR; 9.15 P. M.; *star soloists*; WEAF, WJAR, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ, KSD, WRC, WSAI, WGY, WHAS, WSM, WSB, WMC.

This feature—which comprises the foremost soloists of the operatic and concert stage—is broadcast every Sunday evening over a chain that now includes twenty stations, thus establishing it as perhaps the most widely known as well as the most costly radio program in the world. The solo artist on this program is Giovanni Martinelli, the grand opera star.

March 21

ROXY AND HIS GANG; 7.00 P. M.; *orchestra, with soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WRC, WSB, WHAS, WSM.

RECORD BOYS; 8.00 P. M.; *songs and humor;* WJZ, WBZ.

The "boys" are Al Bernard, Sammy Stept and Frank Kamplain; their best works are negro specialties; their most famous song is the "Sermon on Da Letter S," which is becoming a radio classic.

HIRE'S HARVESTERS; 8.30 P. M.; *instrumentalists;* WEAF, WEEI, WGR, WLIT, WRC, WCAE, WTAM, KSD, WCCO, WSAI.

WILLYS-OVERLAND SYMPHONY; 8.30 P. M.; *symphonic music and soloists;* WJZ.

An ensemble of eighteen musicians, picked from the members of the New York Philharmonic Orchestra and directed by Henry Hadley. A distinguished guest artist is featured each week.

A. AND P. GYPSIES; 9.00 P. M.; *classical and semi-classical music;* WEAF, WEEI, WJAR, WDAF, WRC, WCSH, WTAM, WLIT, WWJ, WCAE, WSAI.

The featured soloist of this group is John Barnes Wells, tenor, widely known as a concert singer and composer and as "America's foremost composer of encore songs"; some of them are to be had on gramophone records. He graduated from Syracuse University in 1901; when he is not filling engagements, he teaches at Princeton.

RUUDE LIGHT OPERA; 9.30 P. M.; *orchestra and soloists*; WJZ, KDKA, WBZ.

Here is a newcomer among the radio entertainers. The programs are confined to light and comic operas. The company numbers fourteen. The conductor is Walter G. Henschen; the soloists are Gladys Rice and Frank Munn.

LIDO VENICE DANCE ORCHESTRA; 10.00 P. M.; *jazz music;* WEEI.

B. A. ROLFE'S DANCE ORCHESTRA; 11.00 P. M.; *jazz numbers;* WEAF.

Broadcast direct from the Palais d'Or Restaurant of New York

March 22

DINNER CONCERT; 6.30 P. M.; WGY.

Those residing in New England and upper New York State who cannot receive well from New York City studios during the early part of the evening, will find in the dinner music of the Hotel Ten Eyck at Albany a type of chamber music that is exceptionally well executed. The orchestra numbers seven pieces.

EDISON ENSEMBLE; 8.00 P. M.; *classic and popular music;* WRNY.

A series of "Twenty-one Adventurous Nights" in the realm of music; the programs are all arranged by Charles D. Isaacson.

THE VIKINGS; 8.00 P. M.; *instrumental trio and guest soloists;* WEAF, WEEI, WJAR, WTAG, WGR, WFI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO, WOC, WGY.

This group specializes in Norwegian music—including folk music and classical compositions of the Norwegian composers.

CHAMPION SPARKERS; 8.30 P. M.; *popular music*; WJZ, KDKA, KYW, WBZ.

A spirited ensemble of eleven men, under the direction of Walter G. Henschen, with two soloists.

JOLLY BUCKEYE BAKERS; 8.30 P. M.; *vocal quartet and instrumentalists;* WEAF, WFI, KSD, WSAI, WCCO, WTAM, WTAG, WLIB, WWJ, WRC.

GRAND OPERA PROGRAM; 9.00 P. M.; *instrumentalists and soloists;* WJZ, KDKA, KYW.

This ensemble is directed by Cesare Sodero.

EVEREADY HOUR; 9.00 P. M.; *varied program;* WEAF, WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI, WTAG, WRC, WGY.

BRIDGE INSTRUCTION; 10.00 P. M.; WEAF, WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO, KSD, WRC, WGY.

Expert instruction in bridge, as played by experts. The hands to be played are given out beforehand by mail upon request; the plays are all announced by Graham MacNamee.

DON AMAIZO; 10.00 P M.; *violinist;* WJZ, KDKA, KYW.

ARROWHEAD INN ORCHESTRA; 10.30 P. M.; *dance music;* WGBS, WIP.

GEORGE OLSEN'S ORCHESTRA; 10.45 P. M.; *dance music;* WJZ.

Broadcast direct from the Hotel Pennsylvania grill-room in New York—with Olsen himself announcing the numbers.

SAM 'N' HENRY; 11.00 P. M.; *negro comedy*; WGN.

Sam 'n' Henry are two comedians who use negro dialect; and, although they appear for only ten minutes, every minute is made lively by clean, wholesome humor.

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	Each
.00007 to .0005 Mfd	35c
.001 to .002 Mfd	40c
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.01 Mfd	55c
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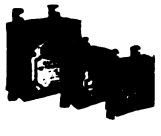

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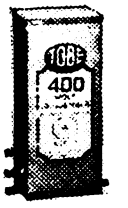

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2,000, 3,000, 5,000, 7,500 and 10,000 ohms	$1.10
50,000 ohms	.90
.1 meg	.80
½, ¼ and 1 meg	.75

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March 23

IODENT'S No. 1 AND No. 2; 8.30 P. M.; *the Mitchel Brothers, banjo and piano;* WJZ, WBZ, KDKA, KYW.

DAVIS SAXOPHONE OCTETTE; 8.30 P. M.; *popular and classic music;* WEAF, WEEI, WJAR, WTAG, WLIT, WRC, WCAE, WTAM, WSAI.

Under the leadership of Clyde Doerr, this group has been increased from a quintette to an octette; its programs are augmented by guest artists.

IPANA TROUBADOURS; 9.00 P. M.; *dance music;* WEAF, WEEI, WGR, WRC, WCAE, WWJ, WSAI, WLIB, KSD, WCCO, WDAF, WGY.

One of the best of the dance-music ensembles, under the direction of Sam Lanin.

MAXWELL HOUR; 9.00 P. M.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW, WHAS, WSB, WMC, WSM.

An excellent group of artists who play not only the compositions of the great masters but some of the best of the lighter music as well. Their programs appeal especially to those who like really good music. Nathaniel Shilkret is the conductor.

SMITH BROTHERS; 10.00 P. M.; *humorous songs;* WEAF, WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO, WDAF.

The youthful "Scrappy" Lamberts and Billy Hillpat make up the popular music team listed as the Smith Brothers—"Trade" and "Mark"—of cough-drop fame. Both these young men lead the musical activities at Rutgers College, Brunswick, N. J., and it was not until they discovered that banjoing was more remunerative than engineering that they accepted the offer to broadcast professionally.

March 24

CLICQUOT CLUB ESKIMOS; 9.00 P. M.; *banjo ensemble;* WEAF, WEEI, WCCO, WGN, WCAE, WGY, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WTAM, WSAI.

Every fan is familiar with the invigorating special music that invariably introduces this feature. Harry Resor is the "Chief Eskimo." As one listener aptly expresses it, "These programs make it feel thirsty!"

RCA RADIOTRONS; 9.00 P. M.; *songs and comedy;* WJZ, WBZ, KDKA, KYW.

A saxophone violin, piano—and a vocal quartet and a comedian.

GOODRICH ZIPPERS; 10.00 P. M.; *popular music;* WEAF, WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WSAI, WCSH, WADC.

An ensemble of light musicians led by Henry Burr.

March 25

HAPPINESS BOYS; 8.00 P. M.; *songs and jokes;* WEAF.

The old vaudeville team of Billy Jones and Ernest Hare has become one of the institutions of the air, despite the fact that it appears only at one station. This team has appeared before the mike not less than 287 times. They compose most of their own songs, but they get their jokes largely from *Judge*.

ROYAL HOUR; 8.30 P. M.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW.

Hawaiian music has been the particular hobby of this group—which means, of course, that it caters to a specialized popular taste. Joe Green is the leader and Charles Harrison, tenor, and Miss Helen Clark, contralto, the soloists.

LA FRANCE ORCHESTRA; 9.30 P. M.; *popular orchestral music;* WEAF, WEEI, WGR, WLIT, WOC, WCAE, WTAM, WWJ, KSD, WDAF.

Miss Anna C. Byrne, conductor, is said to be the only woman leader of a regularly established broadcast ensemble. This group is of outstanding merit—not only in the quality of its playing, but in the selection and grouping of instruments that insure quality in transmission.

March 26

BALKITE HOUR; 9.00 P. M.; *New York Symphony Orchestra;* WEAF, WEEI, WGR, WFI, WRC, WCAE, WSAI, WWJ, WTAM, WGN, KSD, WCCO, WDAF, WOC, WGY.

"OUR GOVERNMENT"; 10.00 P. M.; *talk by David Lawrence;* WEAF, WTAG, WGR, WFI, WRC, WCSH, WGY.

March 27

BEDFORD Y.M.C.A. MEN'S CONFERENCE; 4.00 P. M.; *Dr. S. Parkes Cadman;* WEAF, WEEI, WCSH, WTAG, WCAE, WSAI.

CROSLEY RADIO FEATURE; 5.30 P. M.; *varied program;* WEAF, WEEI, WJAR, WTAG, WGN, WFI, WRC, WCSH, WCAE, WTAM, WWJ, WSAI, KSD, WDAF, WHAS, WSM, WSB, WMC, WGY.

THE CAPITOL GRAND ORCHESTRA (and Major Bowes' family); 7.20 P. M.; *symphonic music and soloists;* WEAF, WEEI, KSD, WRC, WWJ, WJAR, WCAE, WTAG.

COOK'S TOURS; 8.30 P. M.; *travelogue with music;* WJZ.

ATWATER KENT HOUR; 9.15 P. M.; *star soloists;* WEAF, WJAR, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ, KSD, WRC, WSAI, WGY, WHAS, WSB, WMC.

The soloist on this occasion will be Claudia Muzio, soprano—formerly one of the stars of the Metropolitan grand opera galaxy and now of the Chicago opera. While the fees paid for radio appearances are kept secret, it is estimated that they average $1,000 each on the Atwater Kent series.

COLLIER HOUR; 9.30 P. M.; *variety program;* WJZ, KYW, WBZ, KDKA.

This feature is a recent addition to the Sunday night programs, is full of surprises of all sorts—music, interviews with famous authors, discussions of world politics, recitations, the reading of stories, and the philosophical comments of *Collier's* famous "Uncle Henry" go to make up this absorbing hour. It embraces adventure, romance, science, politics, music and the great range of thoughts that pass through the minds of the editors of a national magazine.

March 28

ROXY AND HIS GANG; 7.00 P. M.; *110-piece symphony orchestra, with soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WRC, WSB, WHAS, WSM.

"Roxy," and the members of the old Capitol Theatre gang, have come back to the air. A new 110-piece symphony under the direction of Erno Rapee, and the famous French leader, H. Maurice Jacquet, will be heard together with a studio symphony of 60 pieces and solos from such old favorites as Frank Moulan, Margery Harcum, Gladys Rice, "Wee Willie" Robeyn, Gamby, Douglas Stanbury, Daddy Jim Coombs, and Florence Mulholland. Added to these will be heard regularly a mixed chorus of one hundred voices and selections played on the "largest theatre organ in the world." The program, which fills one and one half hours of broadcasting time, is the most ambitious musical event on the air today.

RECORD BOYS; 8.00 P. M.; *songs and humor;* WJZ, WBZ.

HIRE'S HARVESTERS; 8.00 P. M.; *instrumentalists;* WEAF, WEEI, WGR, WLIT, WRC, WCAE, WTAM, KSD, WCCO, WSAI.

This clever group has been broadcasting popular music for over a year—yet their music-making always seems fresh and crisp; well worth listening to.

WILLYS-OVERLAND SYMPHONY; 8.30 P. M.; *symphonic music and soloists;* WJZ.

A. AND P. GYPSIES; 9.00 P. M.; *classical and semi-classical music;* WEAF, WEEI, WJAR, WDAF, WRC, WCSH, WTAM, WLIT, WWJ, WCAE, WSAI.

WBAL ENSEMBLE; 9.00 P. M.; *chamber music;* WBAL.

In this delightful ensemble Michael Weiner plays the violin, LeRoy Evans is the pianist and Samuel Stone is the cellist. They confine their playing largely to the light classics.

RUUDE LIGHT OPERA; 9.30 P. M.; *orchestra and soloists;* WJZ, KDKA, WBZ.

LIDO VENICE DANCE ORCHESTRA; 10.00 P. M.; *jazz music;* WEEI.

B. A. ROLFE'S DANCE ORCHESTRA; 11.00 P. M.; *jazz numbers;* WEAF.

March 29

DINNER CONCERT; 6.30 P. M.; *classical and semi-classical music;* WGY.

EDISON ENSEMBLE; 8.00 P. M.; *classic and popular music;* WRNY.

THE VIKINGS; 8.00 P. M.; *instrumental trio and guest soloists;* WEAF, WEEI, WJAR, WTAG, WGR, WSI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO, WGY.

CHAMPION SPARKERS; 8.30 P. M.; *popular music;* WJZ, KDKA, KYW, WBZ.

JOLLY BUCKEYE BAKERS; 8.30 P. M.; *vocal quartet and instrumentalists;* WEAF, WFI, KSD, WSAI, WCCO, WTAM, WTAG, WLIB, WWJ, WRC.

GRAND OPERA PROGRAM; 9.00 P. M.; *soloists and instrumentalists;* WJZ, KDKA, KYW.

EVEREADY HOUR; 9.00 P. M.; *varied program;* WEAF, WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI, WTAG, WRC, WGY.

EDUCATIONAL PROGRAM; 9.00 P. M.; *lectures;* WLWL.

In this educational feature members of the faculty of the College of the City of New York appear before the microphone; their lectures are confined to the popular discussion of the world's economic and social problems.

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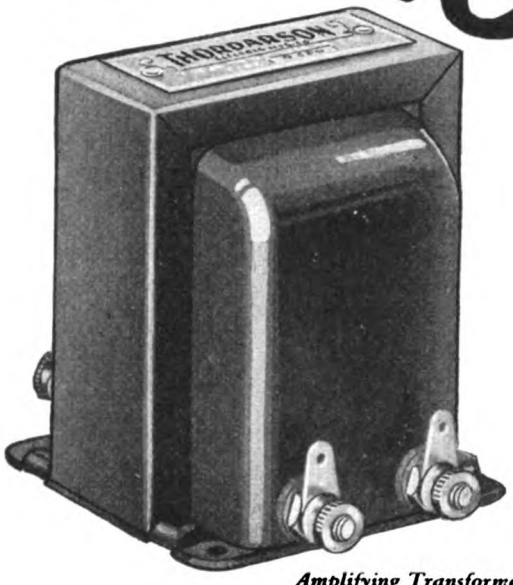

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POWER COMPACT R-171. Contains a power supply transformer, 2 filter chokes, 2 buffer condensers, a five volt filament supply. For Raytheon BH rectifier and UX 171 power tube. $15.00.

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BRIDGE INSTRUCTION; 10.00 P. M.; WEAF, WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO, KSD, WRC, WGY.

DON AMAIZO; 10.00 P. M.; *violinist;* WJZ, KDKA, KYW.

ARROWHEAD INN ORCHESTRA; 10.30 P. M.; *dance music;* WGBS, WIP.

GEORGE OLSEN'S ORCHESTRA; 10.45 P. M.; *dance music;* WJZ.

SAM 'N' HENRY; 11.00 P. M.; *negro comedy;* WGN.

March 30

IODENT'S NO. 1 AND NO. 2; 8.30 P. M.; *The Mitchel Brothers, banjo and piano;* WJZ, WBZ, KDKA, KYW.

DAVIS SAXOPHONE OCTETTE; 8.30 P. M.; *popular and classic music;* WEAF, WEEI, WJAR, WTAG, WLIT, WRC, WCAE, WTAM, WSAI.

IPANA TROUBADOURS; 9.00 P. M.; *dance music;* WEAF, WEEI, WGR, WRC, WCAE, WWJ, WSAI, WLIB, KSD, WCCO, WDAF, WGY.

MAXWELL HOUR; 9.00 P. M.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW, WHAS, WSB, WMC, WSM.

SMITH BROTHERS; 10.00 P. M.; *humorous songs;* WEAF, WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO, WDAF.

March 31

DELLA ROBBIA CONCERT; 7.45 P. M.; *chamber music and solos;* WOR.

This concert (which lasts for thirty minutes) comes from the Della Robbia Room of the Hotel Vanderbilt in New York. At each concert two vocal soloists are featured, usually a soprano or coloratura or a baritone or tenor. This is always a safe port of entertainment in a radio storm.

CLICQUOT CLUB ESKIMOS; 9.00 P. M.; *banjo ensemble;* WEAF, WEEI, WCCO, WGN, WCAE, WGY, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WTAM, WSAI.

RCA RADIOTRONS; 9.00 P. M.; *songs and comedy;* WJZ, WBZ, KDKA, KYW.

WBAL ENSEMBLE; 9.00 P. M.; *chamber music;* WBAL.

GOODRICH ZIPPERS; 10.00 P. M.; *popular music;* WEAF, WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WSAI, WCSH, WADC.

MUSIC BOX HOUR; 1.00 A. M.; *varied program;* KFI.

This unique feature, under the direction of Gene Johnstone and participated in by the Jim, Jack and Gene Trio and a group of soloists, has grown in favor until it is now established as a regular weekly feature of this studio.

April 1

HAPPINESS BOYS; 7.30 P. M.; *songs and jokes;* WEAF.

ROYAL HOUR; 8.30 P. M.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW.

BRUNSWICK-BALKE HOUR; 9.00 P. M.; *varied program;* WJZ, WBZ, KDKA, KYW, WHAS, WMC, WSB.

In this hour of classical music, the Brunswick-Balke-Collender Co. presents to the radio public the various stars that it has under contract for the production of records. The program compares favorably with the past programs of the Victor Talking Machine Co.

RADIO PLAY; 9.00 P. M.; *popular dramas;* WGY.

The WGY Players command the attention of one of the largest radio audiences in the United States. Practically all of the dramas and comedies broadcast have at some time or other been a Broadway hit. The plays usually last one and a half hours. Edward Smith is the dramatic director.

LA FRANCE ORCHESTRA; 9.30 P. M.; *popular orchestral music;* WEAF, WEEI, WGR, WLIT, WOC, WCAE, WTAM, WWJ, KSD, WDAF.

ARMCHAIR HOUR; 10.00 P. M.; *vocal and instrumental music;* WJZ, WBZ.

This feature, in which Marley Sherris, Milton Cross, Keith McLeod, Walter Preston and Godfrey Ludlow participate, has grown to be an easy-to-listen-to institution of this studio. There is quartet singing, violin solos by Ludlow and vibraphone solos by McLeod. The music is usually of the strongly sentimental type. Sherris' portrait is at the left.

April 2

BALKITE HOUR; 9.00 P. M.; *New York Symphony Orchestra;* WEAF, WEEI, WGR, WFI, WRC, WCAE, WSAI, WWJ, WTAM, WGN, KSD, WCCO, WDAF, WOC, WGY.

COLUMBIA PHONOGRAPH PROGRAM; 9.00 P. M.; *varied program;* WJZ, WGY, WBZ, KDKA.

"OUR GOVERNMENT"; 10.00 P. M.; *talk by David Lawrence;* WEAF, WTAG, WGR, WFI, WRC, WCSH, WGY.

BENJAMIN FRANKLIN ORCHESTRA; 10.05 P. M.; *dance music;* WIP.

ARCADIA DANCE ORCHESTRA; 12.00 MIDNIGHT; *dance music;* KMOX.

COLORADO ORCHESTRA; 12.15 A. M.; *dance music;* KOA.

April 3

BEDFORD Y.M.C.A. MEN'S CONFERENCE; 4.00 P. M.; *Dr. S. Parkes Cadman;* WEAF, WEEI, WCSH, WTAG, WCAE, WSAI.

CROSLEY RADIO FEATURE; 5.30 P. M.; *varied program;* WEAF, WEEI, WJAR, WTAG, WGN, WFI, WRC, WCSH, WCAE, WTAM, WWJ, WSAI, KSD, WDAF, WHAS, WSM, WSB, WMC, WGY.

THE CAPITOL GRAND ORCHESTRA (and Major Bowes' family); 7.20 P. M.; *symphonic music and soloists;* WEAF, WEEI, KSD, WRC, WWJ, WJAR, WCAE, WTAG.

Yasha Bunchak, cellist of the Capitol Studio group, has been called the "Heifetz of the cello" by the musical critics of New York. He plays a $30,000 cello which was given to him by General Limoff of the old Russian army. Yasha plays several solos during the Capitol Hour.

COOK'S TOURS; 8.30 P. M.; *talk with music;* WJZ.

ATWATER KENT HOUR; 9.15 P. M.; *star soloists;* WEAF, WJAR, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ, KSD, WRC, WSAI, WGY, WHAS, WSB, WMC.

The guest artist on this concert is Beniamino Gigli, a star tenor of the Metropolitan forces.

April 4

ROXY AND HIS GANG; 7.00 P. M.; *110-piece symphony orchestra, with soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WRC, WSB, WHAS, WSM.

RECORD BOYS; 8.00 P. M.; *songs and humor;* WJZ, WBZ.

HIRE'S HARVESTERS; 8.00 P. M.; *instrumentalists;* WEAF, WEEI, WGR, WLIT, WRC, WCAE, WTAM, KSD, WCCO, WSAI.

WILLYS-OVERLAND SYMPHONY; 8.30 P. M.; *symphonic music and soloists;* WJZ.

A. AND P. GYPSIES; 9.00 P. M.; *classical and semi-classical music;* WEAF, WEEI, WJAR, WDAF, WRC, WCSH, WTAM, WLIT, WWJ, WCAE, WSAI.

WBAL ENSEMBLE; 9.00 P. M.; *chamber music;* WBAL.

RUUDE LIGHT OPERA; 9.30 P. M.; *orchestra and soloists;* WJZ, KDKA, WBZ.

LIDO VENICE DANCE ORCHESTRA; 10.00 P. M.; *jazz music;* WEEI.

JACQUES RENARD ORCHESTRA; 10.05 P. M.; *dance music;* WEEI.

Jacques Renard has what is considered by the connoisseurs of jazz one of the best popular music orchestras in the vicinity of Boston.

B. A. ROLFE'S DANCE ORCHESTRA; 11.00 P. M.; *jazz numbers;* WEAF.

April 5

DINNER CONCERT; 6.30 P. M.; *semi-classical and popular music;* WGY.

EDISON ENSEMBLE; 8.00 P. M.; *chamber music;* WRNY.

THE VIKINGS; 8.00 P. M.; *instrumental trio and guest soloists;* WEAF, WEEI, WJAR, WTAG, WGR, WSI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO, WGY.

CHAMPION SPARKERS; 8.30 P. M.; *popular music;* WJZ, KDKA, KYW, WBZ.

JOLLY BUCKEYE BAKERS; 8.30 P. M.; *vocal quartet and instrumentalists;* WEAF, WFI, KSD, WSAI, WCCO, WTAM, WTAG, WLIB, WWJ, WRC.

GRAND OPERA PROGRAM; 9.00 P. M.; *soloists and instrumentalists;* WJZ, KDKA, KYW.

EVEREADY HOUR; 9.00 P. M.; *varied program;* WEAF, WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI, WTAG, WRC, WGY.

WBAL JUBILEE SINGERS; 9.00 P. M.; WBAL.

EDUCATIONAL PROGRAM; 9.15 P. M.; *lectures;* WLWL.

BRIDGE INSTRUCTION; 10.00 P. M.; WEAF, WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO, KSD, WRC, WGY.

DON AMAIZO; 10.00 P. M.; *violinist;* WJZ, KDKA, KYW.

MUNICIPAL BAND; 10.00 P. M.; *band concert;* WBAL.

The Municipal Band of Baltimore under the direction of Nelsen C. Kratz is conceded to be one of the best city bands in the United States. The pick-up from the auditorium in which the band plays is exceptionally good and those who like band music on the radio will find in this feature something way and beyond the average band transmission.

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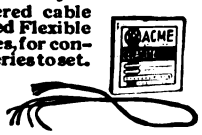

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CORBETT CONSOLE
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Model S-20 Cabinet only	**$27.50**
Model S-25 Table only	**32.50**
Model S-20-25 Combination	**60.00**

Made of high quality, figured walnut plywood. Takes 8" x 26" panel, 25 degree slope. Drop front, and piano hinged top. Baseboard included with each cabinet.

The model S-25 table has 16" x 31" figured walnut top, and is very desirable for use with any table cabinet.

WALNUT INFRADYNE CABINETS.. $26.00
for 7" x 30" panel and 10" x 34" baseboard.

WALNUT HAMMARLUND-ROBERTS HI-Q CABINETS $17.50
for 7" x 21" panel, 12" deep. Chest type, given beautiful high-light finish.

Write for folder showing complete line of consoles, tables and cabinets, and dealers' prices.

CORBETT CABINET MFG. COMPANY
St. Marys, Pa.

ARROWHEAD ORCHESTRA; 10.30 P. M.; *dance music;* WGBS, WIP.

GEORGE OLSEN'S ORCHESTRA; 10.40 P. M.; *dance music;* WJZ.

SAM 'N' HENRY; 11.00 P. M.; *negro comedy;* WGN.

April 6

IODENT'S NO. 1 AND NO. 2; 8.30 P. M.; *The Mitchel Brothers, banjo and piano;* WJZ, WBZ, KDKA, KYW.

DAVIS SAXOPHONE OCTETTE; 8.30 P. M.; *popular and classic music;* WEAF, WEEI, WJAR, WTAG, WLIT, WRC, WCAE, WTAM, WSAI.

The Davis Saxophone Octette is perhaps the only musical organization in the United States that involves only saxophones in different keys. Although the saxophone has never been admitted to the circle of formal music, this octette offers up a particularly entertaining branch of popular selections.

IPANA TROUBADOURS; 9.00 P. M.; *dance music;* WEAF, WEEI, WGR, WRC, WCAE, WWJ, WSAI, WLIB, KSD, WCCO, WDAF, WGY.

MAXWELL HOUR; 9.00 P. M.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW, WHAS, WSB, WMC, WSM.

ARABIAN NIGHTS ENTERTAINMENT; 9.45 P. M.; *varied program;* WGN.

Here is an extravaganza of the air that offers many unusual things in the way of musical entertainment. As this studio does not arrange the actual details of this entertainment until a day or two before its presentation, little may be said beyond a general endorsement of past performances.

SMITH BROTHERS; 10.00 P. M.; *humorous songs;* WEAF, WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO, WDAF.

STEINDEL STRING QUARTETTE; 7.30 P. M.; *classical music;* KMOX.

April 7

CLICQUOT CLUB ESKIMOS; 9.00 P. M.; *banjo ensemble;* WEAF, WEEI, WCCO, WGN, WCAE, WGY, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WTAM, WSAI.

RCA RADIATRONS; 9.00 P. M.; *songs and comedy;* WJZ, WBZ, KDKA, KYW.

WBAL ENSEMBLE; 9.00 P. M.; *chamber music;* WBAL.

GOODRICH ZIPPERS; 10.00 P. M.; *popular music;* WEAF, WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WSAI, WCSH, WADC.

This program has become famous for its variety. It features both instrumental and vocal soloists, quartets, duets, recitations and ensembles. The talent is exceptionally good.

MUSIC BOX HOUR; 1.00 A. M.; *varied program;* KFI.

Anything in the way of musical entertainment may be expected from the KFI Music Box program; it is a variety feature with plenty of surprises each week.

MIDNIGHT FROLIC; 3.00 A. M.; *varied program;* KFI.

This is one of the best variety hours on the air and is especially recommended for those who retire late on Saturday night. The talent is drawn from a "Big Time" vaudeville concert and involves monologues, comedy sketches, singing and instrumental numbers.

April 8

KING EDWARD HOTEL ORCHESTRA; 6.30 P. M.; *dance music;* CNRT.

The King Edward Hotel dance orchestra is said to be the best organization of its kind in all of Canada. The King Edward is Toronto's smartest hotel.

HAPPINESS BOYS; 7.30 P. M.; *songs and jokes;* WEAF.

ROYAL HOUR; 8.30 P. M.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW.

BRUNSWICK-BALKE HOUR; 9.00 P. M.; *varied program;* WJZ, WBZ, KDKA, KYW, WHAS, WMC, WSB.

RADIO PLAY; 9.00 P. M.; *drama;* WGY.

LA FRANCE ORCHESTRA; 9.30 P. M.; *popular orchestral music;* WEAF, WEEI, WGR, WLIT, WOC, WCAE, WTAM, WWJ, KSD, WDAF.

April 9

JACQUES RENARD ORCHESTRA; 6.45 P. M.; *dance music;* WEEI.

BALKITE HOUR; 9.00 P. M.; *New York Symphony Orchestra;* WEAF, WEEI, WGR, WFI, WRC, WCAE, WSAI, WWJ, WTAM, WGN, KSD, WCCO, WDAF, WOC, WGY.

HOTEL CHELSEA ENSEMBLE; 9.30 P. M.; *chamber music;* WPG.

The Chelsea Ensemble supplies the music for the guests of one of Atlantic City's smartest hotels and it provides for the listeners of WPG one of the choicest half hours of chamber concerts now broadcast from any station.

"OUR GOVERNMENT"; 10.00 P. M.; *talk by David Lawrence;* WEAF, WTAG, WGR, WFI, WRC, WCSH, WGY.

BENJAMIN FRANKLIN ORCHESTRA; 10.05 P. M.; *dance music;* WIP.

ARCADIA DANCE ORCHESTRA; 12.00 P. M.; *dance music;* KMOX.

COLORADO ORCHESTRA; 12.15 A. M.; *dance music;* KOA.

April 10

BEDFORD Y.M.C.A. MEN'S CONFERENCE; 4.00 P. M.; *Dr. S. Parkes Cadman;* WEAF, WEEI, WCSH, WTAG, WCAE, WSAI.

CROSLEY RADIO FEATURE; 5.30 P. M.; *varied program;* WEAF, WEEI, WJAR, WTAG, WGN, WFI, WRC, WCSH, WCAE, WTAM, WWJ, WSAI, KSD, WDAF, WHAS, WSM, WSB, WMC, WGY.

THE CAPITOL GRAND ORCHESTRA (and Major Bowes' family); 7.20 P. M.; *symphonic music and soloists;* WEAF, WEEI, KSD, WRC, WWJ, WJAR, WCAE, WTAG.

The Capitol Symphony Orchestra—regarded by some as the best orchestra in New York—is directed by David Mendosa, who is said to be the youngest director of a large symphony in the world. He once played first violin with the Russian and later with the New York Symphony orchestra; he also conducts the studio ensemble.

COOK'S TOURS; 8.30 P. M.; *talk and music;* WJZ.

ATWATER KENT HOUR; 9.15 P. M.; *star soloists;* WEAF, WJAR, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ, KSD, WRC, WSAI, WGY, WHAS, WSB, WMC.

The guest artists are Kathryn Meisle and Leonora Cortez.

COLLIER HOUR; 9.30 P. M.; *varied program;* WJZ, WBZ, KYW, KDKA.

April 11

ROXY AND HIS GANG; 7.00 P. M.; *110-piece symphony orchestra, with soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WRC, WSB, WHAS, WSM.

MALE QUARTET; 7.30 P. M.; *standard songs;* WBAL.

This quartet mixes two rich tenor voices with a basso and a baritone. John Wilbourn and Edward Jendrek are the tenors, while Conner Turner is the baritone and Walter Linthicum is the basso. They confine their activities to the standard old selections, but occasionally sing an unusual number.

RECORD BOYS; 8.00 P. M.; *songs and humor;* WJZ, WBZ.

Here are the "boys"—Al Bernard, Sammy Stept and Frank Kamplain.

HIRE'S HARVESTERS; 8.00 P. M.; *instrumentalists;* WEAF, WEEI, WGR, WLIT, WRC, WCAE, WTAM, KSD, WCCO, WSAI.

WILLYS-OVERLAND SYMPHONY; 8.30 P. M.; *symphonic music and soloists;* WJZ.

A. AND P. GYPSIES; 9.00 P. M.; *classical and semi-classical music;* WEAF, WEEI, WJAR, WDAF, WRC, WCSH, WTAM, WLIT, WWJ, WCAE, WSAI.

RUUDE LIGHT OPERA; 9.30 P. M.; *orchestra and soloists;* WJZ, KDKA, WBZ.

LIDO VENICE DANCE ORCHESTRA; 10.00 P. M.; *jazz music;* WEEI.

B. A. ROLFE'S DANCE ORCHESTRA; 11.00 P. M.; *jazz numbers;* WEAF.

April 12

DINNER CONCERT; 6.30 P. M.; *classical and popular music;* WGY.

EDISON ENSEMBLE; 8.00 P. M.; *classic and popular music;* WRNY.

THE VIKINGS; 8.00 P. M.; *instrumental trio and guest soloists;* WEAF, WEEI, WJAR, WTAG, WGR, WSI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO, WGY.

CHAMPION SPARKERS; 8.30 P. M.; *popular music;* WJZ, KDKA, KYW, WBZ.

JOLLY BUCKEYE BAKERS; 8.30 P. M.; *vocal quartet and instrumentalists;* WEAF, WFI, KSD, WSAI, WCCO, WTAM, WTAG, WLIB, WWJ, WRC.

GRAND OPERA PROGRAM; 9.00 P. M.; *soloists and instrumentalists;* WJZ, KDKA, KYW.

EVEREADY HOUR; 9.00 P. M.; *varied program;* WEAF, WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI, WTAG, WRC, WGY.

ARABIAN NIGHTS ENTERTAINMENT; 9.45 P. M.; *varied program;* WGN.

BRIDGE INSTRUCTION; 10.00 P. M.; WEAF, WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO, KSD, WRC, WGY.

The WEAF bridge instruction period has become a training school for every aspirant to perfection in bridge. This half hour is conducted with the expert assistance of really famous bridge players who, having suggested four hands, tell the listeners how to play them according to the modern practices used in the game.

DON AMAIZO; 10.00 P. M.; *violinist;* WJZ, KDKA, KYW.

SAM 'N' HENRY; 11.00 P. M.; *negro comedy;* WGN.

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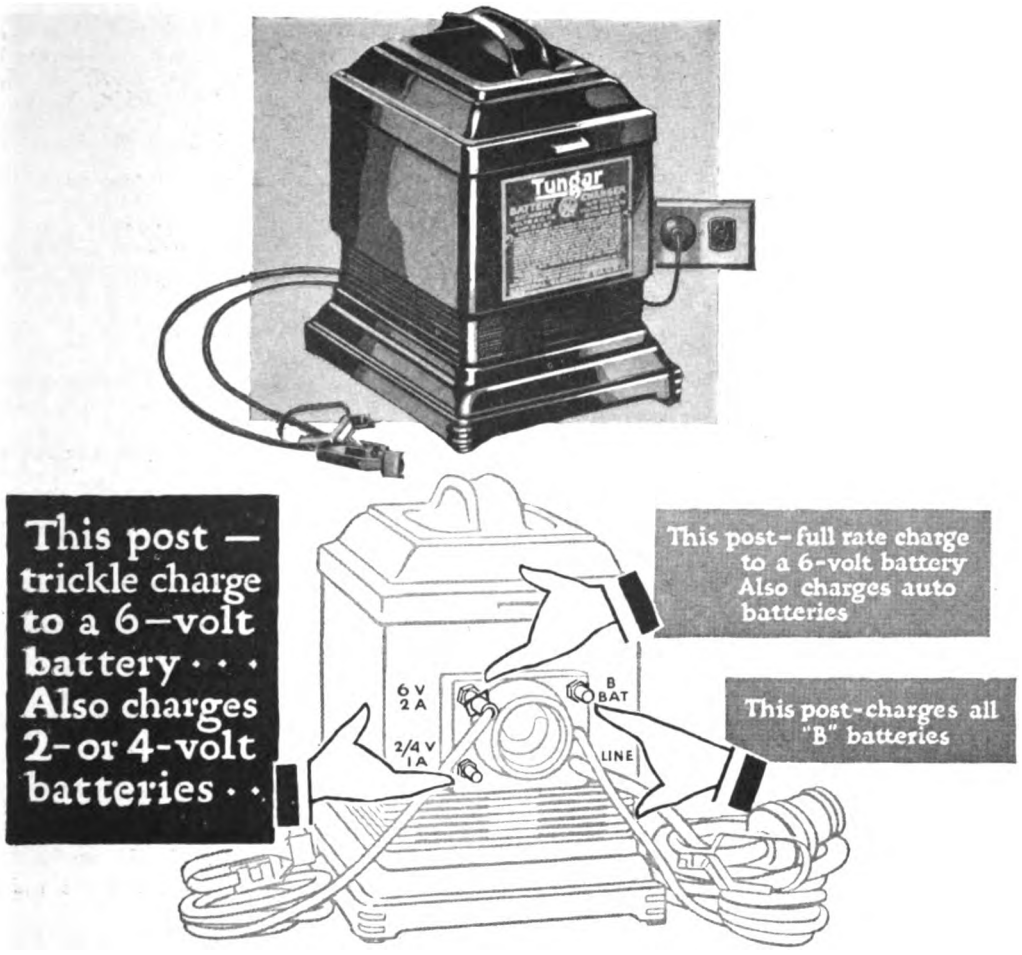
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GENERAL ELECTRIC

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ARROWHEAD INN ORCHESTRA; 10.30 P. M.; *dance music;* WGBS, WIP.

GEORGE OLSEN'S ORCHESTRA; 10.45 P. M.; *dance music;* WJZ.

George Olsen's Pennsylvania Grill Orchestra takes the place of the Vincent Lopez Orchestra that used to play from this place. Olsen does his own announcing and both he and his orchestra is a great favorite with the WJZ audience.

April 13

IODENT'S NO. 1 AND NO. 2; 8.30 P. M.; *The Mitchel Brothers, banjo and piano;* WJZ, WBZ, KDKA, KYW.

DAVIS SAXOPHONE OCTETTE; 8.30 P. M.; *popular and classic music;* WEAF, WEEI, WJAR, WTAG, WLIT, WRC, WCAE, WTAM, WSAI.

IPANA TROUBADOURS; 9.00 P. M.; *dance music;* WEAF, WEEI, WGR, WRC, WCAE, WWJ, WSAI, WLIB, KSD, WCCO, WDAF, WGY.

MAXWELL HOUR; 9.00 P. M.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW, WHAS, WSB, WMC, WSM.

The weekly concert of a very few radio orchestras is anticipated more keenly than that of the Maxwell House group, under the able direction of Nathaniel Shilkret. Mr. Shilkret has in the past used splendid judgment in selecting his music and his programs are invariably mature and well rounded out.

SMITH BROTHERS; 10.00 P. M.; *humorous songs;* WEAF, WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO, WDAF.

JADE ROOM DANCE ORCHESTRA; 11.00 P. M.; *dance music;* WTAM.

The Jade Room Dance orchestra offered by WTAM at 11.00 P. M. on Wednesdays is one of a precious few really good jazz bands in the State of Ohio.

April 14

CHATEAU SOURIER CONCERT; 7.45 P. M.; *chamber music;* CNRM.

MUSIC BOX HOUR; 8.00 P. M.; *varied program;* KFI.

CLICQUOT CLUB ESKIMOS; 9.00 P. M.; *banjo ensemble;* WEAF, WEEI, WCCO, WGN, WCAE, WGY, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WTAM, WSAI.

RCA RADIATRONS; 9.00 P. M.; *songs and comedy;* WJZ, WBZ, KDKA, KYW.

GOODRICH ZIPPERS; 10.00 P. M.; *popular music;* WEAF, WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WSAI, WCSH, WADC.

April 15

HAPPINESS BOYS; 7.30 P. M.; *songs and jokes;* WEAF.

MARKEL'S SOCIETY ORCHESTRA; 8.00 P. M.; *dance music;* WJZ, WBZ, KDKA, KYW.

ROYAL HOUR; 8.30 P. M.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW.

LA FRANCE ORCHESTRA; 9.30 P. M.; *popular orchestral music;* WEAF, WEEI, WGR, WLIT, WOC, WCAE, WTAM, WWJ, KSD, WDAF.

RADIO PLAY; 9.00 P. M.; *drama;* WGY.

DANCE ORCHESTRA; 11.00 P. M.; *dance music;* KDKA.

April 16

JACQUES RENARD ORCHESTRA; 6.45 P. M.; *dance music;* WEEI.

BALKITE HOUR; 9.00 P. M.; *New York Symphony Orchestra;* WEAF, WEEI, WGR, WFI, WRC, WCAE, WSAI, WWJ, WTAM, WGN, KSD, WCCO, WDAF, WOC, WGY.

COLUMBIA PHONOGRAPH PROGRAM; 9.00 P. M.; *varied program;* WJZ, WGY, WBZ, KDKA.

"OUR GOVERNMENT"; 10.00 P. M.; *talk by David Lawrence;* WEAF, WTAG, WGR, WFI, WRC, WCSH, WGY.

BENJAMIN FRANKLIN ORCHESTRA; 10.05 P. M.; *dance music;* WIP.

COLORADO ORCHESTRA; 12.15 P. M.; *dance music;* KOA.

April 17

BEDFORD Y.M.C.A. MEN'S CONFERENCE; 4.00 P. M.; *Dr. S. Parkes Cadman;* WEAF, WEEI, WCSH, WTAG, WCAE, WSAI.

CROSLEY RADIO FEATURE; 5.30 P. M.; *varied program;* WEAF, WEEI, WJAR, WTAG, WGN, WFI, WRC, WCSH, WCAE, WTAM, WWJ, WSAI, KSD, WDAF, WHAS, WSM, WSB, WMC, WGY.

THE CAPITOL GRAND ORCHESTRA (and Major Bowes' family); 7.20 P. M.; *symphonic music and soloists;* WEAF, WEEI, KSD, WRC, WWJ, WJAR, WCAE, WTAG.

COOK'S TOURS; 8.30 P. M.; *travelogue with music;* WJZ.

ATWATER KENT HOUR; 9.15 P. M.; *star soloists;* WEAF, WJAR, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ, KSD, WRC, WSAI, WGY, WHAS, WSB, WMC.

The soloists are Richard Bonelli and Jeanette Vreeland—for this occasion only.

COLLIER HOUR; 9.30 P. M.; *varied program;* WJZ, WBZ, KYW, KDKA.

BAMBO GARDENS DANCE ORCHESTRA; 10.15 P. M.; WTAM.

This ensemble, under the direction of Emerson Gill, is a Cleveland organization recruited from the best popular music players in the "Sixth City." They have "appeared" regularly through WTAM for some time.

April 18

ROXY AND HIS GANG; 7.00 P. M.; *110-piece symphony orchestra, with soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WRC, WSB, WHAS, WSM.

CONGRESS HOTEL DINNER CONCERT; 7.30 P. M.; *chamber music;* KYW.

RECORD BOYS; 8.00 P. M.; *songs and humor;* WJZ, WBZ.

HIRE'S HARVESTERS; 8.00 P. M.; *instrumentalists;* WEAF, WEEI, WGR, WLIT, WRC, WCAE, WTAM, KSD, WCCO, WSAI.

WILLYS-OVERLAND SYMPHONY; 8.30 P. M.; *symphonic music and soloists;* WJZ.

This little symphony is under the personal direction of Henry Hadley, composer and orchestra leader. In assembling this group, Mr. Hadley did all of his recruiting from the ranks of the New York Symphony. With each concert there is presented a guest soloist.

A. AND P. GYPSIES; 9.00 P. M.; *classical and semi-classical music;* WEAF, WEEI, WJAR, WDAF, WRC, WCSH, WTAM, WLIT, WWJ, WCAE, WSAI.

WBAL ENSEMBLE; 9.00 P. M.; *chamber music;* WBAL.

RUDE LIGHT OPERA; 9.30 P. M.; *orchestra and soloists;* WJZ, KDKA, WBZ.

LIDO VENICE DANCE ORCHESTRA; 10.00 P. M.; *jazz music;* WEEI.

B. A. ROLFE'S DANCE ORCHESTRA; 11.00 P. M.; *jazz numbers;* WEAF.

B. A. Rolfe is perhaps the most accomplished cornetist in the United States, certainly the most accomplished on the air. His cornet solos (one of which he usually plays during his concerts) are especially interesting, since he is able to reach and carry melody in the super-treble—a most difficult accomplishment. Previous to his entrance into the realm of popular music, Rolfe directed a formal orchestra, and his jazz orchestration always betrays his training in classical music.

April 19

HOTEL TEN EYCK DINNER CONCERT; 6.30 P. M.; *chamber music;* WGY.

EDISON ENSEMBLE; 8.00 P. M.; *classic and popular music;* WRNY.

THE VIKINGS; 8.00 P. M.; *instrumental trio and guest soloists;* WEAF, WEEI, WJAR, WTAG, WGR, WSI, WCSH, WCAE, WTAM, WWJ, KSD, WSAI, WCCO, WGY.

CHAMPION SPARKERS; 8.30 P. M.; *popular music;* WJZ, KDKA, KYW, WBZ.

JOLLY BUCKEYE BAKERS; 8.30 P. M.; *vocal quartet and instrumentalists;* WEAF, WFI, KSD, WSAI, WCCO, WTAM, WTAG, WLIB, WWJ, WRC.

GRAND OPERA PROGRAM; 9.00 P. M.; *soloists and instrumentalists;* WJZ, KDKA, KYW.

EVEREADY HOUR; 9.00 P. M.; *varied program;* WEAF, WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI, WTAG, WRC, WGY.

EDUCATIONAL PROGRAM; 9.15 P. M.; *lectures;* WLWL.

BRIDGE INSTRUCTION; 10.00 P. M.; WEAF, WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO, KSD, WRC, WGY.

DON AMAIZO; 10.00 P. M.; *violinist;* WJZ, KDKA, KYW.

ARROWHEAD INN ORCHESTRA; 10.30 P. M.; *dance music;* WGBS, WIP.

GEORGE OLSEN'S ORCHESTRA; 10.45 P. M.; *dance music;* WJZ.

SAM 'N' HENRY; 11.00 P. M.; *negro comedy;* WGN.

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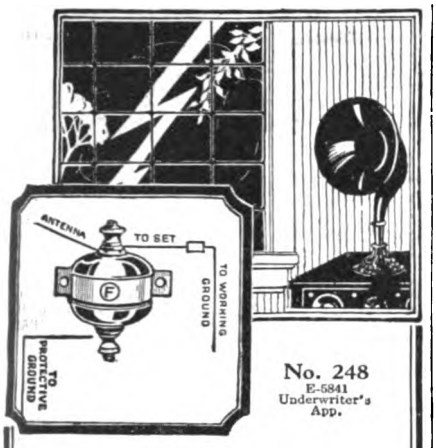

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Henry - Lyford; Carborundum Super;
Popular Science Monthly "Powerful"; "World's Record" Super;
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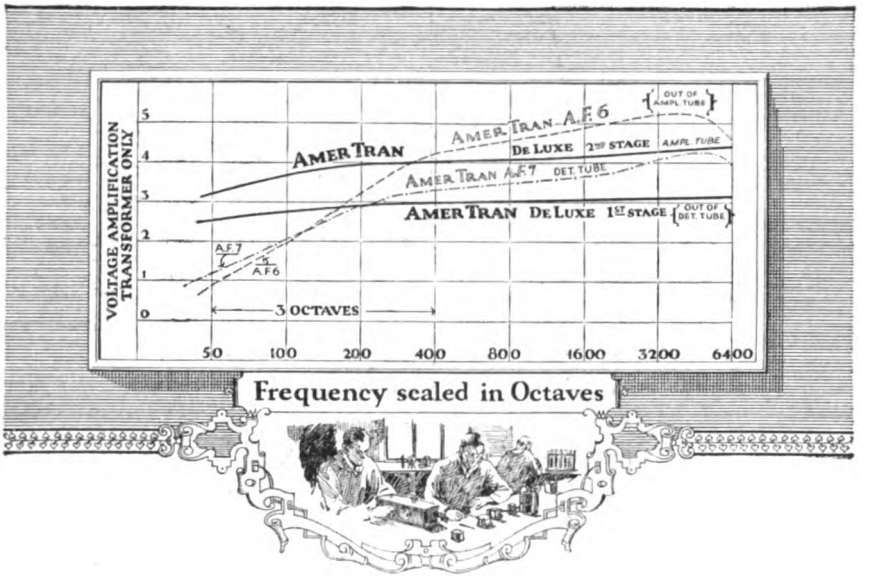
An Explanation of AmerTran DeLuxe Efficiency



The above curves are plotted from measurements made in accordance with the latest tentative rules of the N. E. M. A. These curves have been proven conservative, and accurately represent the AmerTran DeLuxe Audio transformer.

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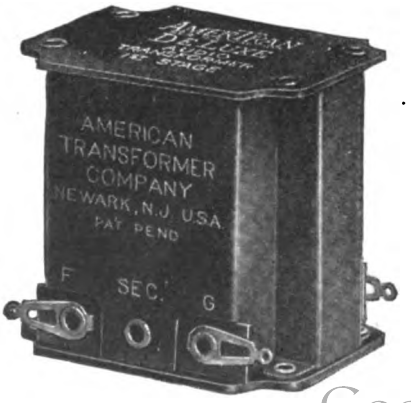

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WITH THE EXPERIMENTERS

CONDUCTED BY RICHARD LORD

How to Make the Coils for the KH-27 Receiver

FOR experimenters who may want to build for themselves the coils for the KH-27 receiver, described in the January, 1927, issue of POPULAR RADIO, this additional information on the coils is provided.

These high-frequency transformers are of remarkable efficiency and through their use the losses in the high-frequency circuits of this receiver have been reduced to a minimum.

It is pretty generally admitted that a solenoid coil with a slight spacing between turns is at least as efficient as any other form and much more efficient than many of the trick forms of coil windings. The ideal coil would be a solenoid in which the turns are supported in air; that is, a coil with no composition tubing or with no foreign material of any kind in contact with the winding. Such a coil is practically impossible, however, as the turns must have some sort of support; and, if the winding is spaced, the support must be complete and rigid in order to maintain the original spacing between the turns.

The coils used in the KH-27 receiver are about as nearly free from dielectric material as any coils could be and still be rigid enough to insure the permanency of the characteristics and values of the coils.

These coils are machine wound on a semi-flexible film of cellulose material and each individual turn is cemented to this film. The result is that there is practically no dielectric between turns, and so little on the inside of the turns (the tubular film) that the losses from this source are so small as to be hardly measurable.

The main coil in the high-frequency transformers has two narrow clamping strips running its entire length, at right angles to the winding, to securely attach the terminal strip to the winding. Inside of the main coil, and approximately ⅛-inch smaller than the main coil in diameter, are the primary and balancing coils which are required in this particular circuit. These smaller coils are equally spaced all around from the larger coil; and this spacing is made permanent by cementing a small spacer between each of these coils and the larger one. The clamping strip which runs through the larger coil serves as the other spacer; thus a rigid two-point suspension is obtained.

The two smaller coils are placed near the filament end of the larger secondary winding and the leads from these coils to the terminal mounting strip are therefore short and kept well distant from the grid end of the large coil. The grid terminal is provided right at the grid end of the coil, so this lead is also extremely short.

On the whole the construction of these transformers is decidedly simple and the entire volume of the dielectric used probably does not exceed that of the wire alone—which is certainly small when compared with the volume of the composition tubes generally used as the support for coils.

To further reduce losses, there are no large masses of metal used in the construction of the units. The terminals are in the form of soldering lugs and are attached to the terminal strip by means of eyelets. There are no bolts or nuts and therefore nothing to work loose. All connections from the windings to the terminals are securely soldered; and the connections from the terminals to the other apparatus, when the coils are mounted in a receiver, must be soldered also. Thus good connections are insured.

The exact specifications of these transformers are as follows:

The coil windings may be purchased from the Hammerlund Mfg. Co. The winding is manufactured in 20-inch lengths and should be ordered by the inch. For the three transformers used in the KH-27 receiver the windings required are:

6½ inches of the 2-inch coil, wound with No. 24 green, silk-covered wire, spaced 40 turns to the inch;
2 inches of the 1⅞-inch coil, wound with No. 26 green, silk-covered wire, spaced approximately 50 turns to the inch.

Three transformers are required;

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these are indicated as T1, T2 and T3 in the constructional article in the January issue. The 2-inch coil winding is used for the three secondary coils; each of these consists of 80 turns. The 1⅞-inch winding is used to make the primary and balancing coils.

The windings specified above are each in one piece, and the individual coils needed to make the transformers must be cut off these windings. In cutting the coils, allow two turns more than actually needed for each of the coils. These surplus turns allow free ends for connection to the terminal strip.

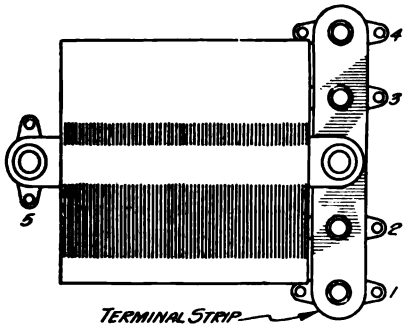
The transformer specifications are as follows:

T1—Secondary coil, 80 turns; primary coil, 15 turns with tap taken off at the 8th turn; balancing coil, 8 turns.

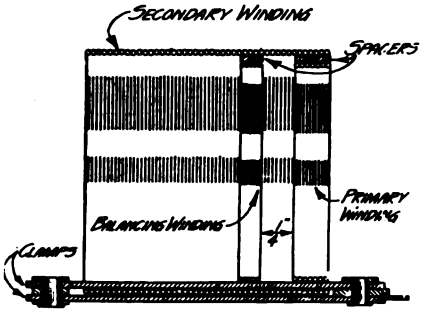
T2—Secondary coil, 80 turns; primary coil, 15 turns; balancing coil 11 turns.

T3—Secondary coil, 80 turns; primary coil, 15 turns; balancing coil, none.

The primary coils are placed inside of the secondaries, at the end next to the



TOP VIEW OF COIL



TRANSVERSE SECTION

HOW THE COILS FOR THE KH-27 RECEIVER ARE MADE

FIGURE 1: *These two drawings, giving a top view and a transverse section of one of the radio-frequency transformers used in the KH-27 receiver, show clearly the general manner in which these coils are constructed. The top drawing shows the soldering lugs attached to the terminal strip by means of eyelets; the bottom drawing gives a clear idea of how the secondary winding is held between two thin strips of bakelite clamped together at the ends, and also how the primary and balancing windings are supported by small spacers cemented to the inside of the secondary.*

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Voltages are readily adapted to plate requirements of all standard tubes in popular use by means of fixed resistances. These resistances are tightly sealed from dust and moisture, thus eliminating bothersome and noisy tendencies of variable resistance voltage controls.

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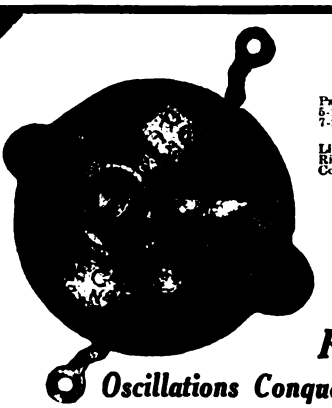

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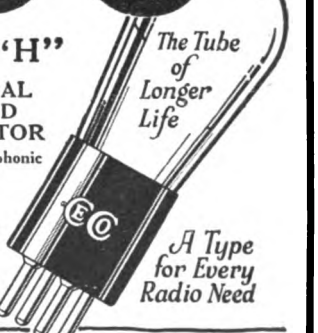

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terminal strips and with the outer edge of the primary coil even with the edge of the secondary. The balancing coils are placed inside of the secondaries and spaced ¼-inch from the inner ends of the primary coils.

The physical arrangement of the assembled transformers is as shown in Figure 1. The connections to the terminals are as follows:

T1—Terminal 1, inner end* of primary; terminal 2, tap on primary; terminal 3, outer end of primary; inner end of balancing coil and outer end of secondary; terminal 4, outer end of balancing coil; terminal 5, inner end of secondary.

T2—Terminals 1, 4 and 5 to be connected, as in the case of T1; terminal 3, outer end of secondary and inner end of balancing coil.

T3—Terminal 1, inner end of primary; terminal 2, outer end of primary; terminal 3, outer end of secondary; terminal 4, not used; terminal 5, inner end of secondary.

—S. GORDON TAYLOR

* Inner end refers to end of coil away from the large terminal strip.

Helpful Hints for Building and Operating the LC-27 Receiver

FIRST of all, in building the LC-27 receiver, be sure that the spacing of the instruments is exactly as shown in the POPULAR RADIO diagram. If the shields are placed incorrectly so that they are closer to the coils than the specifications call for, it will cause your receiver to oscillate excessively.

If the experimenter desires, the pilot light may be controlled along with the five valves, from the battery switch. This is done by connecting the lead from the frame of the dual condenser to the receiver side of the battery switch instead of to the "A" minus connection in the rear of the receiver.

If you want to use the UX-171 type power valve in the last stage of this receiver and to control this valve from the battery switch, you may do so by mounting a half-ampere filament control in front of this socket*. Then connect one side of this filament control to the negative post of this socket and the other side to the receiver side of the battery switch. The "A" positive lead should be bridged over from the fourth socket.

The following suggestions will help those who require extreme selectivity.

If you have not already done so, connect your antenna to binding post No. 2 or, if you are using a power-pack with this set you can dispense with your outside aerial by connecting the ground lead to binding post No. 1. For further selectivity, try a .00015 mfd. fixed condenser in series with your antenna.

* See POPULAR RADIO for March, page 248.

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You can have your choice of any one set of POPULAR RADIO Simplified Blueprints with your new or renewal subscription for POPULAR RADIO, accompanied by remittance of $3.00. These Blueprints will make it possible for you to build a tested and approved set. You, as a reader of POPULAR RADIO, know the many entertaining, interesting and instructive articles that are published each month. We promise that throughout the coming months POPULAR RADIO will hold more and more of interest for Radio Fans.

Ease, Economy and Accuracy in Construction

Simplified Blueprints make it possible for anyone, without previous knowledge of radio, to construct a highly efficient radio receiver. These Blueprints consist of 3 diagrams as follows:

Panel Pattern

This Blueprint is the EXACT size of the actual set. So accurate that you need merely lay it on your panel and drill as indicated. No scaling or measuring to do, no danger of ruining the panel through faulty calculation.

Instrument Layout

Here again you have an actual size print of each instrument and binding post and its exact location both on the panel and within the cabinet.

Wiring Diagram

The unusual feature of this Blueprint is that it is an actual size picture diagram of the finished set. Each instrument and other parts appear in exact size and the wires are so clearly traced from one contact to another that you can connect all terminals accurately without even knowing how to read a hook-up diagram.

Set No. 18—"*The Improved Raytheon Power-Pack*" (as described in the May, 1926, issue of POPULAR RADIO).
Set No. 19—"*The New Home Receiver*" (three tubes, two stages of radio-frequency-amplification with crystal detector, as described in June, 1926, issue of POPULAR RADIO).
Set No. 21—"*The Improved Browning-Drake Receiver*" (as described in the August, 1926, issue of POPULAR RADIO).
Set No. 22—"*The LC-27 Broadcast Receiver*" (as described in the October, 1926, issue of POPULAR RADIO).
Set No. 23—"*The LC-Senior Power-Pack*" (as described in the November, 1926, issue of POPULAR RADIO).
Set No. 24—"*The LC-Intermediate Power-Pack*" (as described in the December, 1926, issue of POPULAR RADIO).
Set No. 25—"*The LC-Junior Power-Pack*" (as described in the January, 1927, issue of POPULAR RADIO).

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A rushing or hissing noise may be due to a noisy UX-200-a type valve. If possible, request your dealer to replace it with a better one, or if your input is great enough, try a UX-201-a type valve as a detector.

A good stunt to try to get rid of this objectionable noise is to connect a .0005 mfd. fixed condenser in parallel with fixed condenser R2. This increases the capacity of this condenser and by-passes some of the extraneous noises.

A high-pitched, whistling sound may be caused by a defective tube in the high-frequency stages or your first low-frequency stage.

The setting of your antenna dial for a given wavelength, should approximate half that of the wavelength dial, as the former has only 50 divisions as compared with the 100 divisions of the latter. The design of the condenser plates may make the tuning of the wavelength dial appear broad; actually this type of condenser (known as midline) provides good spacing between stations.

The "C" battery connection, as shown in the October issue, should be reversed; that is, the "C" minus lead should go to binding post No. 9 and the "C" positive lead to the negative post of the "A" battery.

The volume control that is mounted on the panel of your receiver is a regulator for the plate voltage of your second high-frequency stage. If it is not operating correctly, check over the sliding contact to make sure that the arm is making contact for the full length of the resistance.

If, when this receiver is used with either the Senior, Intermediate or Junior power-pack, reception is marred by a noticeable AC hum, it may be that the line frequency is less than sixty cycles.

To successfully operate the power-packs your line supply should be 110 to 120 volts AC, 50 to 60 cycle.

In some sections of this country the line frequency is in the neighborhood of 25 to 40 cycles. This is true of Buffalo, N. Y., and in some states in the west and also in certain sections of Canada. If your line supply is not of the prescribed frequency it will be necessary to employ a specially wound transformer in your power-pack.

Your power-pack should be kept at least two feet away from the receiver.

A hum may sometimes be caused by an electric light carrying alternating current too near the receiver. A hum may also be caused by AC lighting or power lines running near the antenna.

Be sure that the condensers in the power-pack are in the same relative positions as shown in the POPULAR RADIO diagram. If they are placed too near or against the chokes they decrease the effectiveness of the chokes and cause an objectionable hum.

—CARL DORF

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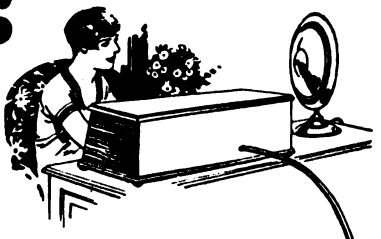

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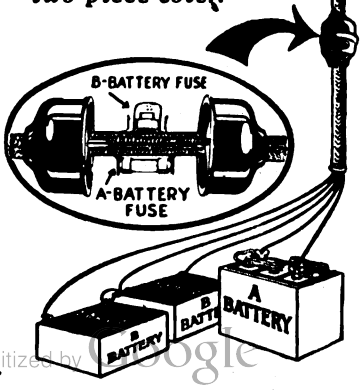

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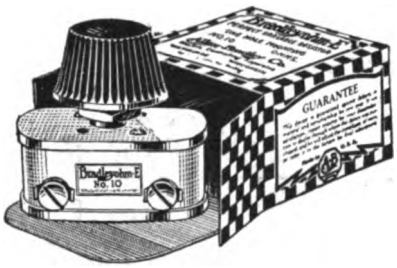

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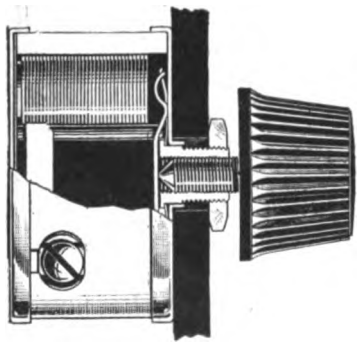

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LISTENING IN

PRACTICAL *pointers from experimenters and broadcast listeners. What helpful hints can* YOU *offer to your fellow fan? Readers are invited to address their letters to the Editor of this Department.*

CONDUCTED BY DAVID LAY

How I Built My "Old Reliable" Four-tube Set

THIS receiver, as I have arranged it, has given me the utmost satisfaction insofar as clarity, distance and volume are concerned. Tuning is very sharp, in fact knifelike. The volume is tremendous and the distance obtained is all that can be expected.

A few evenings ago I tuned in on this set, San Diego, Calif., three stations in Texas, two in Kansas, one in Nebraska, one in Colorado, one in Louisiana, one in Mississippi, three in New York City, the St. Paul-Minneapolis station, one in Missouri, one in Tennessee, one in Alabama, one in Washington, D. C. and one in Atlantic City; and all of these were received on the loudspeaker! All musical notes were reproduced with life-like fidelity.

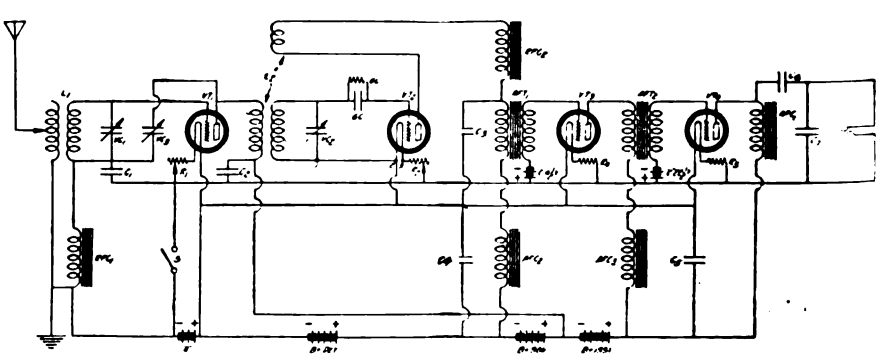
The circuit (see Figure 1) consists of a regenerative detector with a stage of radio-frequency amplification ahead of it and two stages of transformer-coupled audio after the detector.

The first tube is neutralized; in this way the tendency for this tube to oscillate is eliminated. The detector tube, as shown, has its filament connections wired for the standard UX-201-a type of tube. In order to use the new UX-200-a detector it will be necessary to connect point "1" to point "3" instead of to point "2" as at present shown.

The parts that I used in constructing this receiver are:

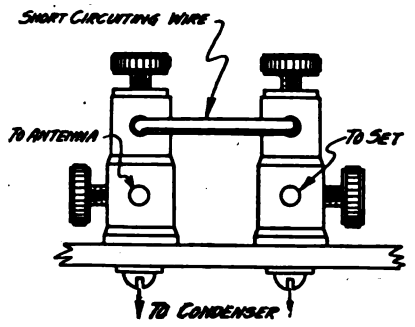
L1—General Radio 267D antenna coupler;
L2—Uncle Sam 3-circuit Tuner;
VC1 and VC2—Karas variable condensers, .0005 mfd.;
VC3—Variable baby .000045 condenser;
VT1, VT2, VT3 and VT4—Benjamin cushion type UX sockets;
C1—Sangamo fixed condenser, .0001 mfd.;
C2—Sangamo fixed condenser, .006 mfd.;
C3—Sangamo fixed condenser, .002 mfd.;
C4, C5 and C6—Tobe fixed condensers, 4 mfd.;
C7—Sangamo fixed condenser, .001 mfd.;
AFT1 and AFT2—General Radio audio transformers, old type (small), ratio 3 to 1 and 2 to 1, respectively;
AFC1—Thordarson output choke, 85 MH;
AFC2 and AFC3—Sampson audio-frequency chokes 3½ henries;
RFC1 and RFC2—Sampson radio-frequency chokes, 85 MH;
R1 and R2—Yaxley rheostats, 20 ohms;
R4—Amperite No. 1-A, with mounting;
R5—Amperite No. 112, with mounting;
GL—Lynch metallized 2-meg. grid-leak;
GC—Sangamo fixed condensers, .00025 mfd., with clips;
S—Yaxley filament switch and pilot light;
J—Small Yaxley Imp jacks, for cord tips;
Panel, 7 by 24 inches;
Sub-panel, 8 by 22 inches;
2 Benjamin adjustable brackets;
2 Marco vernier dials, large;
3 Marco dials, rheostat size;
1 Yaxley 4-point inductance switch;

—MARVIN C. WILLIAMS, *Dept. of Mechanics Air Corps Technical School, Chanute Field, Ill.*



THE SCHEMATIC DIAGRAM OF THE RECEIVER

FIGURE 1: *The circuit consists of one stage of high-frequency amplification, a regenerative detector and two stages of transformer-coupled, low-frequency amplification.*



HOW TO GET LOW WAVES

FIGURE 2: *You can tune down to lower wavelengths by inserting a variable condenser in the antenna circuit. A short-circuiting wire between the binding posts may be used to cut out the condenser when it is not desired by the fan.*

Tuning Down to 200 Meters

IF you are still operating the receiver that you purchased two or three years ago you may be missing the programs that are put on by stations that use wavelengths below three hundred meters. You can get in on these low wavelengths by inserting a 21-plate variable condenser in the antenna circuit.

I did this without involving any extra switches or troublesome movable parts.

As there was no room for the condenser inside the cabinet, I secured a piece of panel, size 4 by 5 inches, to a baseboard, size 4 by 4 inches, and mounted the condenser on the panel, leaving room for two double set-screw type binding posts underneath. I connected the two terminals of the condenser to the two binding posts, the aerial to the inside hole of one and the aerial post of the set to the inside hole of the other binding post. When you do not wish to use the condenser you may short-circuit it by placing a short piece of bus bar in the two outside holes.

—JOHN C. HEBERGER, *Rochester, N. Y.*

* *

An Efficient Home-made Radio Lug

INSTEAD of soldering an ordinary lug to the end of a stranded wire I twisted the loose strands of the wire together and bent them to form a hook. To reinforce the stiffness of the hook which served as a lug, I put a drop of solder on it and put the hook in a flame which caused the solder to flow between the strands. While the solder was still soft I then flattened the hook, with pliers, to make a better contact surface.

This lug cost nothing and is no harder

A SIMPLE HOME-MADE LUG

FIGURE 3: *A little solder is allowed to run through the strands of wire to make the*

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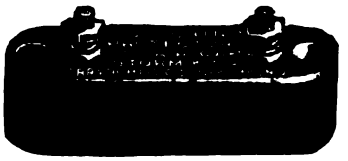

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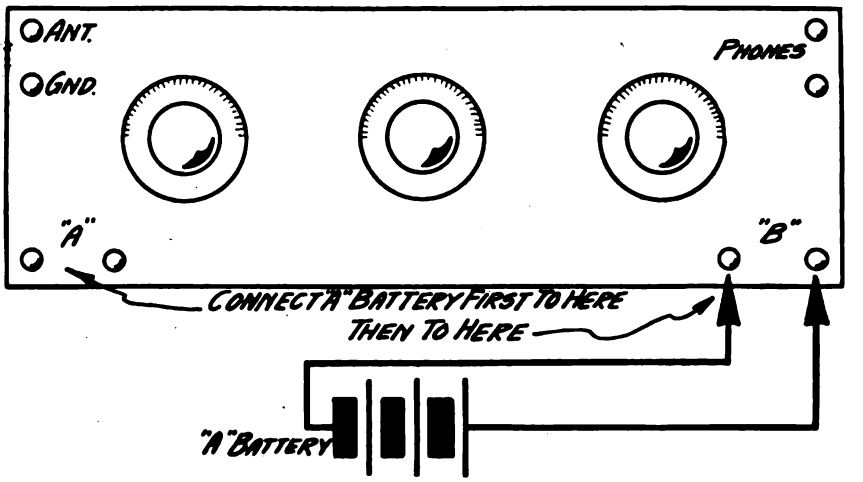


A SIMPLE BATTERY CONNECTION TEST

FIGURE 4: *To make sure that the wiring in your set is correctly done, before you wire it up to the batteries, insert the tubes in their sockets and touch the tips of the "A" battery leads to the "A" terminals of the set. The tubes should light. Then touch the leads to the "B" terminals of the set. If the tubes light now, there is a short circuit.*

to make than it is to solder a manufactured lug to a wire.

—FRANK HARAZIM, *New York City*

* *

A Simple Battery Connection Test for Your Set

ONE of the most aggravating things that a listener can do to his receiving set is to burn out the tubes by accidentally connecting the "B" battery across the filament. This danger can be overcome by utilizing the simple test shown in Figure 4.

When the set is ready to hook-up to the batteries, put the tubes in their sockets and connect the "A" battery (the filament battery) to the "A" battery binding posts. If the connections are all correctly made, the tubes will light. Then, disconnect the "A" battery from the "A" battery binding posts and connect it to the "B" battery binding posts on the set.

Now, the tubes should not light. If they do light, it shows that they would have been burned out if the set had been connected up in the regular manner without a preliminary test, and that a wrong connection must be corrected.

—CHARLES F. FELSTEAD (6CU), *Los Angeles, Cal.*

How I Get Clearer Reception

I HAVE found that a one-microfarad condenser, connected across the "B" battery, as shown at C1 in Figure 5, often makes a considerable improvement in the strength and quality of the music received on a set. The reason for this is the fact that the condenser bypasses the radio-frequency current so that it does not have to pass through the "B" battery. If the "B" battery is rather old, its voltage is likely to fluctuate because of the uneven chemical action within the cells; this will cause frying and crackling noises in the set.

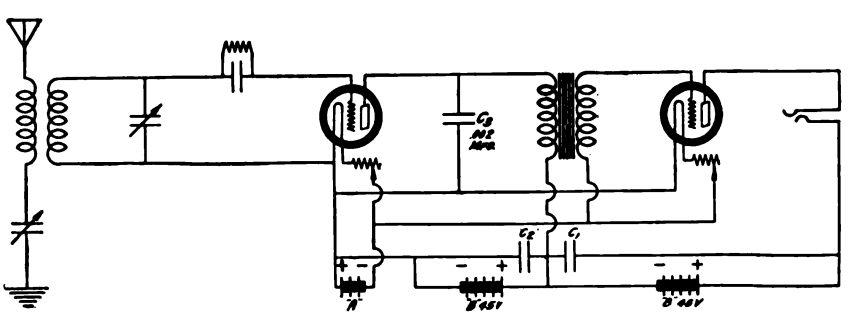
It is an advantage sometimes to connect an additional condenser of about .1 mfd., C2, across the portion of the "B" battery that is used for the detector.

—CHARLES F. FELSTEAD (6CU), *Los Angeles, Cal.*

* *

How I Made My Own Grid-Leak

I HAVE found that I can make a grid-leak by taking a small strip of cardboard that has been dipped in India ink and then clamping each end, through the



HOW RECEPTION MAY BE IMPROVED

FIGURE 5: *A one-microfarad condenser connected across the "B" battery, as shown at C1, may considerably improve the quality and strength of reception. A .1-microfarad condenser connected across the detector part of the "B" battery sometimes also improves reception.*

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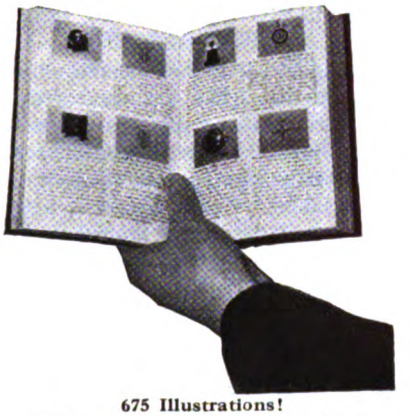

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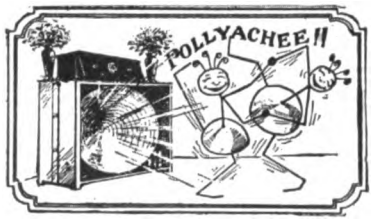

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This simple resistance often comes in handy when I am experimenting with a new receiver.

—JOHN WESLEY, *Morristown, N. J.*

* *

How to Get Into Tight Corners When Soldering Connections

I HAD nearly finished my new set when I found that I had just one more wire to solder. And my soldering iron was so such a size that it was impossible for me to get at the joint to apply the heat.

By taking an extra length of bus bar and wrapping it tightly around the point of the iron, I added a length sufficient to reach into the parts to be soldered. This extra piece, about an inch long, made it easy to get at the work.

Not only did this small piece of metal carry enough heat for the soldering but, as it had already been tinned, the soldering was simplified. The larger the wire that is used, the more heat it will carry and the better will be the work of soldering.

In doing soldering, it is better and neater to place under the joint a piece of heavy paper. This will pick up all of the odd pieces of solder falling down into the apparatus and may readily be removed without leaving any more debris.

—ARTHUR NUYOL, *Lakewood, O.*

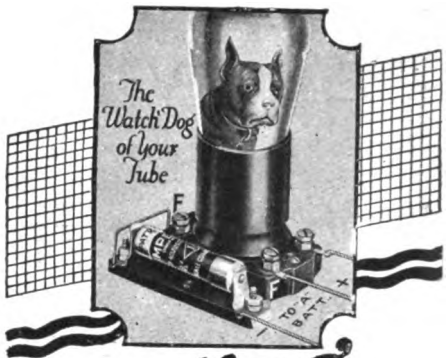
* *

How to Connect the Loud-speaker Properly

IT is very important to have your loud-speaker connected properly to your set, for if the current flows through it in the wrong direction, the permanent magnet will be gradually demagnetized. To check this point, turn up the tubes to normal brilliancy, tune in a station, and move the adjusting knob or lever on the speaker until the speaker rattles slightly. Then reverse the cord tips. If the rattling increases, or if the music stops or becomes faint, it indicates that the current is now flowing through in the right direction, pulling the diaphragm closer to the poles of the magnet. The cord tips should be left connected this way, and the adjustment changed until the speaker is working properly. If however, when you reversed the cord tips, the slight rattle clears up more or less, this indicates the wrong connection, as the current is now opposing the permanent magnet, and pushing the diaphragm farther away from the magnets. The cord tips should be connected again as at first.

This method cannot, of course, be used on speakers not provided with an adjustment. Also, a few do not need to be connected in any special way.

—HOMER E. HOGUE, *Venice, Cal.*



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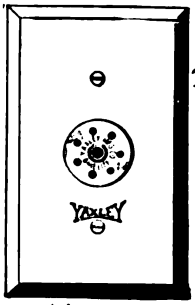

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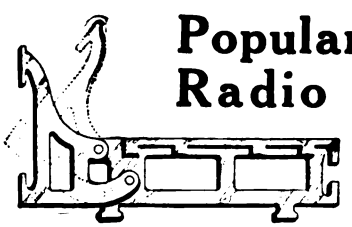

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How to Build the New Standard Browning-Drake Receiver

(Continued from page 335)

denser, but the pitch should not vary when a proper neutralization has been accomplished.

How to Tune the Receiver

First, rotate the tickler which is controlled by the small knob to the right of dial Y2, to maximum position.

Next set the second dial, Y2, until a whistle is heard. This is the carrier wave of the transmitting station beating with the oscillations the set is producing and will be heard if a station is transmitting.

Turn back the rotor coil so that the whistle disappears and, at the same time, turn the left-hand dial, Y1 (the first condenser), until the signals are loudest. Readjust the two tuning condensers, Y1 and Y2, and the tickler coil until satisfactory volume is obtained. It will be found that the rheostat, V, makes an excellent volume control for tuning it down, regulating the signals received, without detuning the set.

The receiver is very selective—much more so than any Browning-Drake previously described; it is, therefore, necessary to tune the circuits to exact resonance in order to obtain the best quality.

Always regulate the volume by the rheostat, V, and the tickler coil—never by setting the dials Y1 and Y2 off resonance.

In case the builder is located in a nest of local broadcast stations, a metal panel and metal cabinet will stop any pick-up from the local stations on the coils and wires of the set so that outside stations should be easily tuned in while locals are operating. Ordinarily, this is not necessary.

Do not expect to get reception of distant stations up to 2,000 or 3,000 miles with the receiver every night—static and other interference will not permit it on any set, regardless of design. However, the receiver described, if carefully built and operated, will perform exceptionally well.

Many experimenters ask what type of antenna to use. The answer, as the authors see it, is to use a vertical antenna—that is, one as high as possible of from 50 to 70 feet in length. It will be found that the receiver performs well on a much shorter one, such as 10 to 20 feet of wire in the same room with the receiver. It should, however, be placed as high above the set as possible. Good insulation on the antenna system is important.

The ground connection should be made to a water pipe by means of a ground clamp. Radiators are sometimes suitable, especially if the heating system is hot water.

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If you are already engaged in building a receiver, make sure that your transformers are by Ferranti. At slight added expense they will give it the best in tone and volume—and those are the two qualities most prized today!

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Chosen by EXPERTS

GLENN H. BROWNING, Laurence M. Cockaday, Gerald M. Best and many other eminent radio designers use the Lynch Metallized Resistor in their experimental circuits and receivers. These men *know* radio; they have laboratory and testing equipment with which quickly to make accurate comparisons. There could be no better proof of the true merit of the Lynch Metallized Resistor than the endorsement of these experts.

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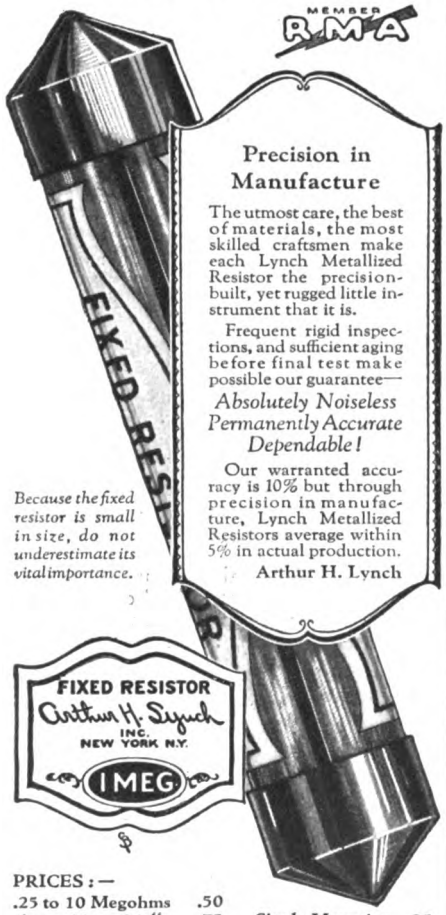

Because the fixed resistor is small in size, do not underestimate its vital importance.

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.25 to 10 Megohms	.50		
above .01 to .24 "	.75	Single Mounting	.35
.001 to .01 "	$1.00	Double "	.50

Lynch Metallized Resistors cost no more than the ordinary kind. If your dealer cannot supply you it will be well worth your while to wait for the mail—we ship post-paid, at once.

LYNCH METALLIZED FIXED RESISTORS

Practical Hints for Starting Your Radio Laboratory

(*Continued from page 355*)

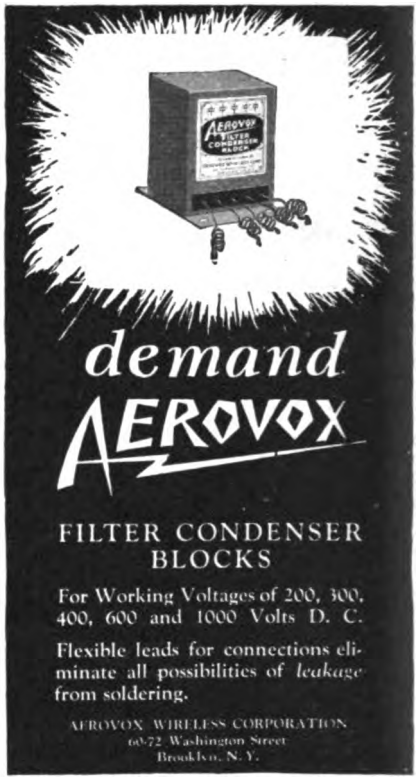
tubes, we find that the "B" battery flow is reduced to 4.9 milliamperes, while the flow is 6.3 milliamperes when we use the 3-volt tap on the "C" battery. This shows that with the full 4½-volt "C" battery bias our "B" battery will last something like 70 per cent longer. If our meter has no fractional-volt post connection (usually used for reading amperes, in connection with external shunts) it is quite possible that we can save the cost of a milliammeter by sending our 30-volt (or any similar value) meter to the manufacturer to have a binding post added, connecting directly to the rotor coil in the meter.

If this turns out to be impractical, it is still possible to use our 30-volt meter in circuit with our "B" battery and get an accurate enough milliampere value, for our purpose, because the direct-current resistance of a tube is so much higher (something about 20,000 ohms) than the resistance of the 30-volt circuit of our meter, that the error is not prohibitive. Subtracting 20 percent from the reading when using the 30-volt scale of the meter, will just about compensate for the error, for all practical purposes.

EXPERIMENT No. 5: *Checking the Energy Taken from an Antenna.*

We have read somewhere that the energy taken from an antenna, fairly near a broadcasting station, is of the order of .0001 amperes, or 100 microamperes, so we decide to see what we can do toward checking this on our set, as our antenna is just one-third of a mile from a station using 1000 watts. Knowing that our 30-volt meter has about the same resistance as our cheaper headphones, and that the coil in the meter is wound with fine wire somewhat on the same principle as the coils in the telephones, we decide that if the meter is substituted for the telephones in our crystal set, we will get a good approximate idea of the energy delivered to our phones from the antenna, through the vario-coupler and crystal.

Having heard as far as Pittsburgh (from Chicago) on good nights in winter, with our crystal set, we feel confident that it will show up well. Making our connections of the meter to the phone binding posts, with the "positive" post of the meter to the crystal side of the detector, we find that the 30-volt scale reads a shade under 1 volt. It is not possible to read the number of tenths of a volt accurately, as the scale has scale lines only for volts and half volts, but it looks like nine tenths of a volt, so we multiply that into the figure of .6 milliampere and get .9 × .0006 = .00054 ampere, which is about half a milliampere, or 540 microamperes.



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For Working Voltages of 200, 300, 400, 600 and 1000 Volts D. C.

Flexible leads for connections eliminate all possibilities of *leakage* from soldering.

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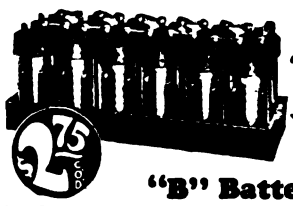
"A" Current From Your Light Socket

World "A" POWER UNIT

Automatically provides even, unvarying "A" current from the moment you throw on your set switch. Finer reception, uninterrupted by "fade-outs" and "screeches." Absolutely noiseless. Assures full tone quality from your set and wider D X range. A marvelous improvement—at less than half the cost of any similar equipment. Shipped complete, subject to inspection, on receipt of price—or C. O. D. if you wish.

$12.75 Complete

25 Amp. Unit for sets of 4 tubes or less—$12.75
60 Amp. Unit for sets of 5 tubes or more—$15.75
5% discount if cash in full is sent with order.



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How to use

Resistance in Radio!

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Resistance assumes major importance in radio as higher voltages and currents are employed in power supply units.

"How to Use Resistance in Radio" tells the proper use of resistance and outlines many of the new A.C. and D.C. power circuits. It will be sent postpaid for 15c.

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BEFORE you build or buy a radio be sure to consult our new 100 page catalog — sent to you free. All the latest kits, accessories and parts — a million dollar radio stock to choose from.

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Chicago Salvage Stock Store

Dept. PR, 509 S. State Street, Chicago, U. S. A.

Measuring with other stations tuned in fairly broadly, we get the following energy readings:

Station Rating in Watts	*Distance in Miles*	*Energy in Micro-amperes*
3500	1¼	600
1000	⅓	450
1500	4	60
500	2	30
3500	15	30

Having found that our new crystal set, with a vario-coupler, with both the antenna and the detector circuits tuned to resonance gives much better volume and sensitivity than our old crystal set with a variometer connected directly to antenna and ground and to the detector, we measure the energy on the old set with the same stations tuned in, and find that the two nearest stations register only about half as compared with the new set, and that the deflections on the other stations are too small to read.

There are many, many measurements that we can make, along these lines. It becomes obvious that readings of fractional ampere flow of currrent will be subject to appreciable error if we have only a scale of 5 to 50 volts. Also, we can not read differences with our eye, on the scale, when testing resistance, where the scale difference between V and γ is less than 1 volt, but we can readily seal the moving arm of a high-resistance potentiometer with the included resistance about 20 to 30 times the known resistance of the meter coil, and then use the total of these two resistances as our R figure; and this enables us to make fairly accurate tests of unknown resistances up through still another range of higher values of resistance, by using more battery voltage in the higher test range.

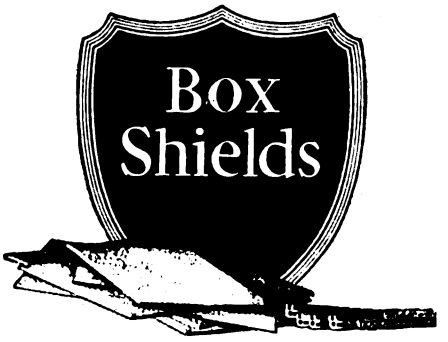
"Buzzing" with Bussey in Brazil

(*Continued from page 367*)

After describing our sets and exchanging some personal conversation, Bussey complained of lack of sleep, so we made arrangements to get in touch again on the following night at midnight and then signed off.

At the time of this communication the G. M. Dyott Expedition was encamped at Palmital, so named because of the lone palm which stands there; it was to this palm that his antenna was fastened.

Bussey deserves considerable credit for his excellent work—all the more so because the results he obtained were obtained under severe handicap and with limited facilities. His operating was certainly of the best and his form excellent; without these, it would have been impossible to have copied his signals through the interference and atmospheric noises which are so often present on the lower wavelengths.



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MEETING the highest radio standards—shipped to you in the most convenient knocked-down form for easy assembly. These Box Shields are made of heavy Aluminum (.080"-No. 12 B. & S.) and are supplied 5"x 9"x6", which will cover most requirements. If the size does not meet your exact needs, change it —Aluminum is easy to work.

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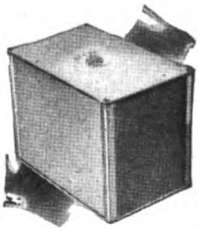
Those who use Aluminum have ample proof of its advantages. Insist on "Alcoa Aluminum," ask your dealer or write us.

"ALCOA ALUMINUM" Box Shields

Consist of: Top, Bottom, Sides
4 Extruded Corner Posts
8 Aluminum Screws



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What Built the Reputation of

Mayolian
"B" SUPPLY

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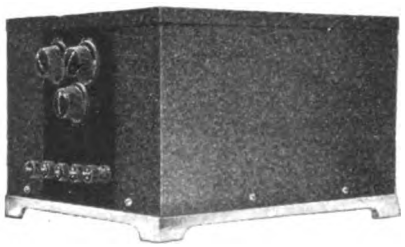
The "B" Without a Buzz



Type 612
Delivers 40 Mils at 180 volts
All voltages are adjustable
Complete with Raytheon Tube $42.50

PIONEERING in battery elimination, Mayolian was probably the first manufacturer to adopt the now far-famed Raytheon tube as the heart of its B Supply Units, and to earn the approval of Raytheon. From that day to this, each Mayolian has been rigidly held to the standards of the Raytheon and Mayolian laboratories. Years of exhaustive research, extreme precision in manufacture, skilled supervision —all these have contributed to the pre-eminent position of Mayolian.

Today, no matter what make or type of receiver you have, there is a Mayolian to give it a continuous, uniform, noiseless "B" supply—direct from the nearest light socket, at half the cost of burning a 25-watt lamp.

The Heavy Duty Types of Mayolian employ the new Raytheon B H tube

The nearest dealer will gladly demonstrate in your own home. Write us.

MAYOLIAN
RADIO CORPORATION
1668 Webster Ave., New York, N.Y.

Pioneers in Battery Elimination

MEMBER RMA

The Power of Niagara— The Quiet of an Arctic Night

Your Laboratory Tools

(*Continued from page 357*)

tool is well equipped for oiling, trouble will eventually result from worn parts.

In Figure 3 is shown the countershaft which is manufactured especially for this lathe. When the countershaft is mentioned, the experimenter immediately brings up the question, "Why is it not possible to belt the lathe directly to the driving motor?" First off, the question of variable speed is involved—different jobs on the lathe require different spindle speeds and this cannot be accomplished without cone pulleys. Putting a resistance in series with a motor might come as another suggestion. This would be impractical because it *would reduce the power delivered to the work on the lathe.* When a resistance is introduced into the circuit with an electric motor, the ratio of the power to the speed drops instantly.

In Figure 2 there is shown a suggested arrangement of the motor, the countershaft, the bench and lathe. This is the ideal arrangement.

Due to local difficulties, this arrangement was not followed out in the installation of the lathe photographed. The countershaft was placed on the bench back of the lathe with the motor inverted under the bench. Of course, a hole had to be cut through the bench to accommodate the driving belt. Due to the particular construction of this countershaft, the high speed or large pulley cannot be used with this arrangement because the shifting fork on the power belt will not permit it.

The countershaft under discussion is provided with a total of five pulleys; three of these are cast in one piece to form the cone while the other two are independent. One is an idler pulley upon which the belt of the motor runs while the lathe is stopped.

By the pedal arrangement shown in Figure 2, the lathe operator may push the driving belt A (Figure 3) over to the power pulley of the countershaft F. This countershaft is provided with small cone bearings the wear of which may be taken up by adjusting the screw D in Figure 3.

A word about the belt shifting arrangement. A piece of one-inch wood stock about eighteen inches long is provided with a hinge and fastened to the floor, as shown in Figure 2. This is connected to the countershaft belt shift by a piece of picture wire.

Remember that the large pulley on the shaft must be opposite the small pulley on the lathe. Otherwise variable speed would be impossible because the ratio of the diameter of one of the pulleys to the one opposite would always be the same.

In the next article the writer will analyze the parts of the lathe more carefully and show the experimenter how he may proceed with small turning jobs.

YOUR RADIO PROBLEMS SOLVED

POPULAR RADIO maintains for the benefit of its readers a Technical Service Bureau and Laboratory, which will, without charge, answer by personal letter any question or problem submitted by a subscriber. **This service is, however, also available to readers, other than subscribers, at the very nominal rate of $1.00 the inquiry.**

In writing please confine your questions to one general subject, writing on one side of the paper only, and enclose a self-addressed and stamped envelope.

It is possible that your individual problem has been covered in an issue of POPULAR RADIO, and so as an aid to you we endeavor to keep a supply of back numbers in stock. The condensed index below gives a few of the subjects that have appeared recently: look this list over and if the information you want is covered, we will be pleased to supply back numbers at 35c. a copy.

May, 1926
—How to Draw Up Your Own "Tuning Graphs."
—How to Build the Improved Raytheon Power-pack.
—How to Build an Antenna Mast for $15.00.
—Fifteen Ways to Reduce Static.
—Do Your Coils Broadcast?

June, 1926
—How to Build the New Home Receiver.
—How to Put Up a Good Outdoor Antenna.
—How to Get the Most Out of Your Ready-made Receiver.
—Audio-frequency Amplification. How to Get it Without Distortion.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.

July, 1926
—How to Get the Best Reception in Summer.
—The Best Crystal Set for $13.00.
—How to Build the Newest Portable "Town and Country" Receiver.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.
—How to Get the Most Out of Your S-C Receiver.

August, 1926
—A New Method of Using Harmonics for Determining Frequencies.
—POPULAR RADIO Circuits.
—How to Build the Improved Browning-Drake Receiver.
—How to Pick Out a Loudspeaker.
—How to Get the Most Out of Your "Town and Country" Receiver.
—Three Vacuum Tubes in One.

September, 1926
—Foretelling Radio Reception from the Weather Map.
—How to Build an Impedance-coupled Amplifier.
—A Radiant Crystal Pilot.
—POPULAR RADIO Circuits.
—How to Simplify Your Set with Automatic Filament Controls.
—Inside Information on New Radio Receivers.
—How to Wire Your House for Radio.

October, 1926
—How to Build the New LC-27 Receiver.
—The Radio Road Hog.
—POPULAR RADIO Circuits.
—Sets That Earn Incomes.
—Inside Information on New Radio Receivers.
—Why Signals Fade.

November, 1926
—How to Build the LC-Senior Power-pack.
—Waves and Wavelengths.
—POPULAR RADIO Circuits.
—How to Select Your Radio Parts.
—How to Patent Your Radio Inventions.
—How to Solder.

December, 1926
—Uncle Sam's New Short-Wave Net.
—How Circuit Resistance Affects Selectivity.
—POPULAR RADIO Circuits.
—How to Build the LC-Intermediate Power-pack.
—Inside Information on New Radio Receivers.

January, 1927
—How to Build the New KH-27 Receiver.
—To Start and Stop Your Set Automatically.
—POPULAR RADIO Circuits.
—The Quack Doctors of Radio.
—How to Build the LC-Junior Power-pack.

February, 1927
—The Coming of the "RADIO UNIVERSITY."
—How to Get Quality Amplification.
—How to Build and Use a Portable Test-Board.
—How to Assemble the All-Amax Senior Three-tube Reflex Receiver.
—What's New in Radio.

March, 1927
—How to Build the Univalve Receiver.
—POPULAR RADIO Circuits.
—How to Increase the Range of Ammeters and Voltmeters.
—How to Build Your Own 36-Inch Cone Loudspeaker.
—What's New in Radio.

POPULAR RADIO
Dept. 48
627 W. 43d St., New York

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Resistance-coupled Amplifiers

(*Continued from page 340*)

3. Shunt a similar winding across the ordinary grid resistance; this is usually done in the last stage.

In rare cases it may be necessary to place choke coils in one or more "B" plus (+) leads. Experiment alone will determine this. The diagram shown in Figure 5 gives some suggestions for trials.

In other rare cases, particularly with six-tube and super-heterodyne receivers, the use of partial "B" battery operation gives best results. Figure 6 shows this method with a complete wiring diagram.

Of course, as has been shown many times before, it is always preferable to completely eliminate the "B" voltage from the loudspeaker. The method shown in Figure 7 is a most excellent one, which at the same time produces better quality, eliminates demagnetization of the unit and prevents burnt windings. This method embraces the use of a high inductance choke and a large fixed condenser in the loudspeaker circuit.

Simply changing the resistors, as shown, will, in ninety-nine cases out of a hundred, give perfect results with "B" power-packs.

* *

The Curse of Fame

I have been written about so often. It is becoming monotonous.

There was the news item stating that radio owners were the most contented home lovers on earth.

I was one of the radio owners.

There was the feature story referring to the great number of listeners to a certain radio program.

I was one of the listeners.

There was the statistical review giving the number of radio fans (estimated) in the United States.

I was one of the fans.

One radio magazine announced that it had more subscribers than any other publication.

I was one of the subscribers.

There was the article announcing that a certain midwestern broadcasting station put on a program that was heard by millions and millions.

I was one of the millions and millions.

I have been written about so often. It is becoming monotonous.

—FRANK ROMANO

* *

In a German Laundry the operators have jazz programs by wireless while they work. Perhaps this is to help them in putting the syncopated edge on the collars.

—WIRELESS MAGAZINE

Vee Dee

Metal Panel and Sub-Panel

FOR THE

S. C. II Receiver

(SILVER COCKADAY)

Price of complete unit — including all necessary screws, nuts, bolts and bushings, individually packed in convenient container . . $5.00

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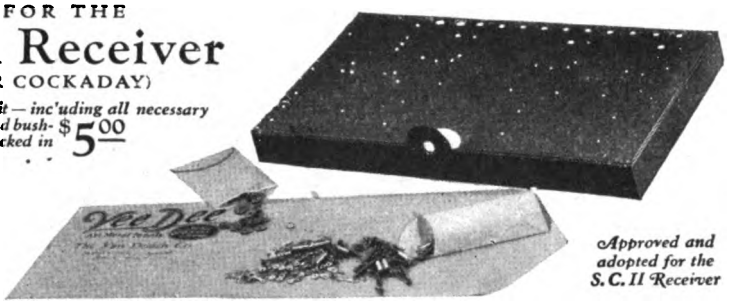

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VEE DEE METAL PANELS *for* **Nationally Famed Kits—Drilled and Decorated**

L. M. Cockaday LC-27, **$3.70**
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by the engineers who designed the popular and efficient S. C. II Receiver. The panel is accurately drilled, beautifully finished and artistically decorated. The sub-panel is designed for easy mounting and wiring—is rigid in construction and precisely in position for all outlets and inputs.

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We invite correspondence from manufacturers who want special designs worked out. Write for details.

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NATIONAL

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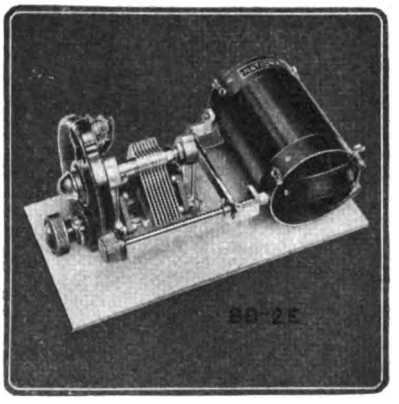

NATIONAL Tuning Units comprise the famous BROWNING-DRAKE Coils and R. F. Transformers with their Slot-wound primaries, the new NATIONAL EQUITUNE Condensers with their light and rigid Girder Frames, and the NATIONAL ILLUMINATED Velvet-Vernier Dials.

DESIGNED AND OFFICIALLY APPROVED By GLENN H. BROWNING

NATIONAL Tuning Units are standard for good Radio sets. So are NATIONAL Impedaformers for quality audio, NATIONAL Tone-Filters, for power tube output connection.

NATIONAL Co., makes heavy-duty B-Supply Units and 3-stage Power Amplifiers. Write National Company, Inc., W. A. READY, President, Cambridge, Mass., for Bulletin 116-L-4.

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ENGINEERING *and* MASS PRODUCTION

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Dongan's reputation for being a step ahead in transformer design, and a large factory devoted entirely to the production of parts, has placed Dongan transformers and chokes as standard equipment in many leading sets and battery-eliminators.

As a source of supply you will find the utmost in cooperation in the Dongan organization.

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Dongan Transformers and Chokes for use with Raytheon BA 350 MA and Q. R. S. 300 MA Rectifying Tubes
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TRANSFORMERS of MERIT for FIFTEEN YEARS

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A good name
NA-ALD
in radio

Use Power tubes for good quality at full volume

Simply adapt to your set with

Connectoralds
(Reg. U. S. Pat. Off.)

The use of a Power Tube in the last audio will very greatly improve your tone quality. No change in set wiring is necessary when Connectoralds are used.

For UX 171 and UX 112 Tubes, Na-Ald 112 Connectoralds are recommended for maximum volume with storage battery sets. These tubes will deliver without distortion several times the volume of the regular 201A. Price $1.50.

For UX 120 Tubes in UV 201A sockets, the Na-Ald No. 120 Connectorald should be used. To convert a storage battery set to dry batteries with ample loud speaker volume, use a UX 120 tube in the last audio stage with the 120 Connectorald and UX 199 tubes with 419X Adapters in the other sockets. Price $1.25.

For the UX 120 Tube in UV 199 sockets, ample loud speaker volume without distortion is obtainable from any set equipped for UV 199 tubes by means of the UX 120 or equivalent tube, with the Na-Ald No. 920 Connectorald. The tube is raised slightly, but provides for its use in most sets with limited headroom. Price $1.25.

For UX 120 tubes in the UV 199 sockets of the Radiola Superheterodyne Semi-Portable and Radiola Super VIII. These excellent Superheterodynes will deliver ample volume for loud speaker operation when equipped with the UX 120 used with the Na-Ald No. 420 Connectorald. Price $1.25.

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Dept. 321-C Springfield, Mass.

Model AC15

The Amplion Grand
List Price $135

This remarkable instrument utilizes an entirely new principle in radio reproduction—a combination of soundboard, air-column and cone. This results in a marvelous depth of note-resonance and a fine natural tone.

Every Amplion Grand sold is a laboratory model, personally tested and approved by Amplion's Chief Engineer.

The handsome walnut cabinet 34" x 33" x 18½" is sturdily built—its rich finish will grace the most beautifully appointed room.

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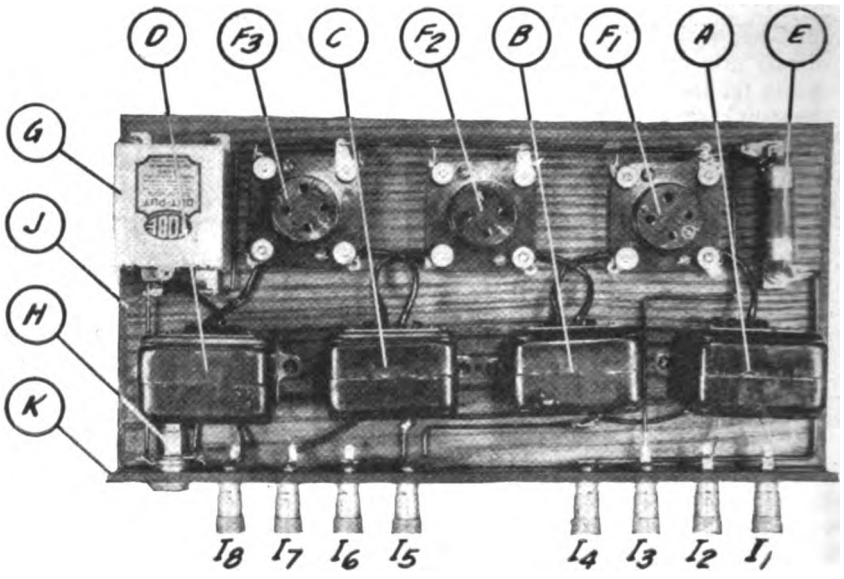
AMPLION

How to Get Quality Amplification

(Continued from page 341)



THE AMPLIFIER AS SEEN FROM ABOVE

FIGURE 4: *This picture shows how the completed unit should look. The instruments are all fastened down to the baseboard by means of short, brass wood screws.*

How to Construct the Unit

To build the amplifier, cut the baseboard, J, to the proper size, 6 by 12 by ½ inch. Then prepare the binding-post strip, K, as shown in Figures 3 and 4. This should run the entire length of the baseboard.

Next, attach the eight binding posts, I1, I2, I3, I4, I5, I6, I7 and I8, as shown in Figure 3, and attach the jack, H, as shown in the same diagram.

The first two binding posts, I1 and I2, are for the input connections to the receiver with which the amplifier is to be used; binding posts I3 and I4 are for the negative and positive terminals of the "A" battery; binding posts I5 and I7 are for the "C" (—) minus battery terminals. The positive "C" battery terminal is connected to the negative terminal of the "A" battery; binding posts, I6 and I8, are for the "B" (+) battery connections for the intermediate tubes and for the last tube.

The negative "B" battery terminal should be connected to the "B" (+) plus terminal of the detector battery, as shown in Figure 1. After the binding-post strip, K, has been attached to the baseboard, J, by means of three screws inserted through the holes in the strip and into the edge of the baseboard, the other instruments may be mounted on the baseboard (see Figures 3 and 4).

The instruments may be fastened down in their correct relative positions by means of wood screws driven into the baseboard, J.

The wiring should be done exactly as shown in Figure 3; this carries out the wiring scheme given in the schematic drawing in Figure 2. When the wiring is completed, the unit is ready to be installed.

In Figure 1 is shown the method of connecting to the detector and to the batteries that are to be used with the amplifier. Insert two Truphonic Hi-Mu valves in sockets, F1 and F2, and insert a UX-112 type power valve or a UX-171 type power valve in the last socket, F3.

The amount of "C" battery used will depend upon the type of tube used in this last socket.

When the valves have been placed in their respective sockets, the amplifier is ready for use. It should be used with a reproducer that is capable of producing high quality signals. The reproducer is plugged in by means of a phone plug into the jack, H.

The receiver, that this unit is used with, should be tuned in the usual manner and the quality of reproduction will be found to be excellent even when the volume is raised to the full undistorted output of the power valve.

Here Is One Solution to Power Troubles

Watch the next issue of POPULAR RADIO *for the complete constructional details of an improved totally shielded power unit for use with a gaseous rectifier-type valve that gives higher output "B" voltages with an increased number of voltage combinations. It will also supply the "A," "B" and "C" voltages for the last valve in the receiver.*

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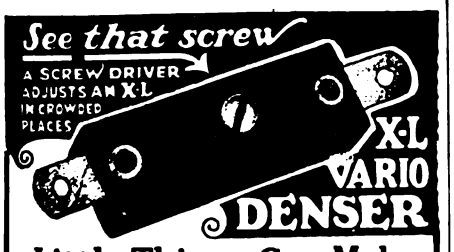

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Panel size, 36"x9"x¼" Super 10-tube Standard Admiralty Model Weight: 55 lbs.

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—Thoroughly shielded at all necessary points.

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1	Western Electric Cone Speaker, 540AW or Farrand Sr., and Plug	32.60
1	Set Antenna Equipment, complete	5.00
2	"C" Batteries	2.00
	TOTAL COST OF ALL ITEMS—NOTHING ELSE REQUIRED	$441.10

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What's New in Radio

(*Continued from page 365*)

has been made in order to obtain this high degree of selectivity.

The "Super-Selector" makes use of six vacuum valves in all. The first two are used in the two stages of tuned-high-frequency amplification. The third valve, which may be of either the UX-200-a type valve or the 201-a type, functions as a detector. The last three valves are used in a three-stage "Truphonic" low-frequency amplifier. This is one of the newer types of low-frequency coupling which provides really excellent tone quality with ample volume.

The coils and condensers in the three tuned circuits are completely shielded; this accounts in part for the selectivity of the receiver and tends to eliminate local disturbances such as noise from power lines and other sources.

Each of the vacuum valves is equipped with a fixed, filament-control resistance of the cartridge type, with the exception of the first two, which operate through a single, fixed resistance. All of these resistances are removable, however, and may be replaced with resistances of different values if so desired. This makes it possible to use any valve combination desired. For instance, if a UX-201-a type tube is to be used in the last low-frequency stage, a ¼-ampere resistance is used. If a UX-112 type or a UX-171 type power valve is to be used it is a simple matter to plug in a ½-ampere resistance instead. When the receiver leaves the factory it is provided with suitable resistances for the use of UX-201-a type tubes in all but the last stage. Thus the receiver may be kept up to date by taking advantage of any new types of tubes that may be brought out.

Provision is made in the receiver for separate "B" and "C" battery connections for the last low-frequency stage. This permits the owner to choose the type of vacuum valve to be used in this stage. The use of a power valve is recommended, because the volume of reproduction obtained with the volume control turned up full is more than sufficient to overload a UX-201-a type tube. If a "B" power-pack is used in place of "B" batteries, and it is capable of delivering around 180 volts for the plate of the power tube, the UX-171 type valve is to be preferred. If 135 volts of "B" battery are used then the UX-112 type valve is a more practical valve to use because of its lower current consumption, and because of a correspondingly longer life for the batteries.

The battery requirements, at least so far as the "B" batteries are concerned, are a little out of the ordinary in that four different voltages are recommended, namely, 22½, 67½, 90 and the high voltage for the power valve (135 to 180 volts). If batteries are used, this requirement presents no difficulties. But "B" power-packs have terminals for only three voltages. The writer has found, however, that the 67½-volt lead from this receiver may be connected to the same terminal of the power-pack as is the 90 volt wire. At least this works out satisfactorily where the power-pack used is one which makes provision for varying the voltage for the detector and intermediate voltage requirements of the receiver.

The filament-current requirements of the receiver are taken care of by a 6-volt storage battery, or any standard type of "A" power-pack, or a combination storage battery and trickle charger. In other words, any device may be used providing it is capable of delivering 1¾ amperes for the operation of the filaments of the receiver.

The "C" battery requirements depend on the type of vacuum valve used in the last stage. The instructions packed with power tubes give complete information on this point. In any event, the dry-cell type of batteries are recommended for this use. They are small in size and have extremely long life when used for this purpose. Some "B" power-packs, however are designed to provide the "C" voltage as well as the "B" voltages.

An outdoor antenna about 100 feet in length, including the lead-in, is suitable for use with this set. Where the utmost selectivity is required, however, an antenna about 75 feet in length, over all, should provide best results especially in a locality where there are numerous broadcasting stations. In suburban locations where there is no possibility of strong interferance between stations, an antenna up to 150 feet in length will give best results.

The Elkay receiver is inclosed in an attractive mahogany cabinet of the table-mounting type which measures 25 inches long, 14 inches wide and 11 inches high. The front of the cabinet, or panel is also of mahogany and slopes back.

In the center of the front panel is a large and artistic, antique silver escutcheon plate through which the tuning controls projected in the form of three thin disc. These have knurled edges to afford a good finger grip. On the sides of two of these discs are smaller and wider drums which are calibrated, and which move with the larger drums to indicate the relative setting of these two tuning controls.

The three tuning discs are placed flat up against each other and at right angles to the panel so that just a sector projects through the opening in the escutcheon plate. The center disc is about an eighth of an inch larger in diameter than the other two so that its circumference will project slightly beyond the others and therefore make is possible to adjust this control without interfering with the adjustment of the other two. It is possible to tune the receiver with one hand by means of a clutch arrangement in which all three discs are turned by simply revolving the center disc.

In addition to the three controls for individual circuits, there are two other knobs on the panel. One is the battery switch by means of which the receiver is turned "off and on," and the other is a control which gives the operator full control over the volume of reproduction.

Maker: Langbein-Kaufman Radio Co.

How to Reduce Interference

By the use of a device known as a "Pre-Selector" (to be described in POPULAR RADIO *for next month), the selectivity of ANY receiver may be*

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THE importance of the proper flux for radio soldering, has become so significant, that manufacturers of better radio sets have, after extensive laboratory tests, adopted Kester Rosin Core Solder—alert set builders, too, use nothing but Kester Radio Solder, the handy size package of Kester Rosin Core Solder.

Pure rosin, as in Kester Radio Solder, is absolutely non-corrosive and is the only safe flux for radio. Being a hard, dense substance, rosin will not attract and collect dust (carbon particles) which forms a path for leakages. Chloride fluxes in either paste, liquid or compound form are highly corrosive. They absorb moisture from the air, and when heat is applied, a spattering, fuming and spreading action is caused. The areas over which flux is thus spread attract and collect dust (carbon particles) which forms an excellent path for leakages and soon impairs the receptive quality of any set.

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0.0002			
0.00025		0.005	70c.
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With Resistor clips, 10c. extra.

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RADIO DIVISION, *50 Church Street, New York*

The Three Blankets Around the Earth

(*Continued from page 330*)

wegian scientist, Professor Carl Stormer, has observed and photographed these beautiful streamers and curtains which seem to flash up from the magnetic pole of the earth on winter nights. He has observed some of them at heights as great as nearly five hundred miles above the ground. The average height is about sixty to seventy miles, well within that mysterious outer blanket of warm air which is also the Heaviside Layer. Undoubtedly the Aurora is caused by streams of electrified particles, probably free electrons, reaching the earth from the sun and traveling downward along the lines of magnetic force centering at the magnetic pole.

Undoubtedly, also, these solar particles produce the glow of the Aurora by hitting against atoms of the earth's upper air. Dr. Lars Vegard, a distinguished Norwegian physicist often quoted in POPULAR RADIO, has devoted much investigation to the problem of what atoms it is that are giving out this Auroral light. He believes that he has located at least one of the atomic sources in solid particles of frozen nitrogen. Another scientist, Professor J. C. McLennan of the University of Toronto, doubts Professor Vegard's conclusions. He proposes other atomic candidates as responsible for the Aurora; a mixture of atoms of helium with atoms of oxygen.

When this uncertainty has been resolved; when we know, as undoubtedly the Aurora will one day tell us, just what atoms we are dealing with in those outermost lightest and fluffiest layers of the earth's third blanket; we will be able to go far toward determining just what kinds of electric changes in the air atoms are responsible for the remarkable properties of the Heaviside Layer; properties so useful to our present-day radio.

715 Broadcast Stations

TODAY there are 715 broadcasting stations in the United States—a gain of 177 broadcasters over a year ago. This includes twenty-two portable transmitters. Disregarding these transient stations, the State of New York leads with 61 fixed stations, Illinois stands second with 60. When portable sets are taken into consideration, Illinois is first by about eight stations. The list by states shows that California is third with 52 stations; Pennsylvania fourth, with 44, next, Ohio with 34. The next twelve states follow in order: Texas, 32; Washington and Michigan, 27 each; Iowa, 25; Missouri and New Jersey, 24 each; Wisconsin, 20; Massachusetts 19; Nebraska, 17; Indiana, Minnesota and Florida, 16 each. Nevada remains the only state without a single station, as it stood last year.

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Outstanding quality confirmed by lasting good performance on over 50,000 sets. The following interesting endorsements are but a few out of thousands—but actually your best means of verifying our claim of "singular value" in the good Ferbend "B" Eliminator.

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RICHMOND, VA.
Your Eliminator has got it all over any that I ever used and I tried several different makes costing much more.—Wm. H. Bryant.

DULUTH, MINN.
I have used your Eliminator for over a year and it is one of the best investments I ever made.—L. W. Peters.

NILES, OHIO
The Eliminator I purchased from you a year ago has given results that could not be surpassed regardless of price. I have logged KFI, KGC, KFON, CZE, and 6 KW.—F. I. McGuirk.

Original cost less than half of any equipment of similar quality; lowest maintenance cost. Model III, for all sets using 90 Volts..... **$12.50**

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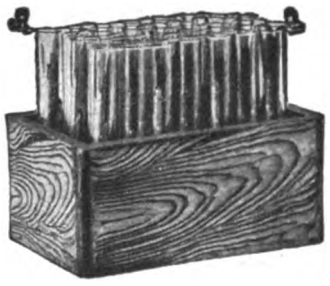

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What's New in Radio

(Continued from page 366)

and the three tuned circuits are therefore adjusted simultaneously by the operation of this control.

In order that these three circuits may be tuned by a single control it is essential that the values of the circuits be carefully matched. This requires careful attention; and it has apparently been worked out with a high degree of success. The calibration of the wavelength indicator scale appears to be carefully adjusted also, as the maximum variation found was less than two per cent and the average variation less than one per cent.

The receiver is designed to use either standard vacuum valves, or the valves manufactured by the Magnavox Company. The recommended tube equipment consists of three of the standard UX-201-a type valves (or three of the Magnavox type A valves) for the two high-frequency amplifier stages and for the first low-frequency stage. For the detector a UX-200-a type valve is recommended, and for the second low-frequency stage a power tube of the UX-112 or the UX-171 types should be used. The UX-201-a type valves may be used throughout if desired, but the sensitivity and volume of the receiver will suffer in consequence of this change.

As the manufacturer of this receiver especially recommends the use of the UX-171 type power tube it is advisable to equip the receiver with a "B" power-pack by means of which the high voltage for the plate supply can be obtained from the house lighting lines. The current drain of this power valve is comparatively large and would be hard on "B" batteries. If batteries are used, however, they should be of the heavy-duty type. A "B" power-pack capable of supplying about 180 volts at 25 to 30 milliamperes will give excellent results with this receiver. Taps should be provided for the 45-volt and the 90-volt supplies.

To light the filaments of the five tubes either a six-volt storage "A" battery or an "A" power-pack capable of supplying approximately 6 volts at 1½ amperes may be used.

The grid-biasing voltage for the power valve may be obtained either from a dry-cell battery or from the "B" power-pack if the latter is one of the type which supplies this "C" voltage as well as the "B" voltage. If dry-cells are used, one of the smallest size "B" batteries is quite suitable. The biasing voltage required will vary from 26 to 40 volts, depending on the amount of "B" voltage used.

The installation of the receiver is simple, as it is equipped with a battery cable, the individual wires of which are plainly marked for the proper terminals. The end of the cable that goes to the receiver terminates in a plug arrangement; this eliminates the necessity for binding-post terminals at the receiver.

An outdoor antenna about 75 feet long, including the lead-in, will produce good results with this receiver. In locations close to broadcasting stations, however, this length may be cut down to 50 feet or so; or a small fixed condenser of about .00025 mfd. may be connected in series with the lead from a longer antenna to give the same effect, so far as increased selectivity is concerned.

During the tests of this receiver it was found possible to tune in one station after another by simply starting with the dial setting for 200 meters and then slowly turning the control knob. Even using a 100-foot antenna, with a small fixed condenser in series, it was found possible to tune in many out-of-town stations without interference from the numerous and powerful local stations. A number of Chicago stations were brought in during the early evening, with excellent volume and a good quality of reproduction.

Maker: The Magnavox Company.

A Space-saving Jack

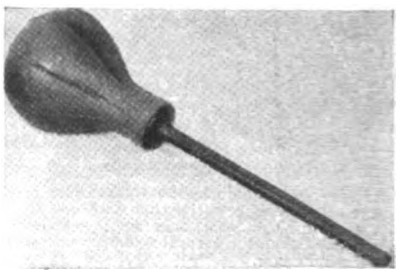
Name of instrument: Jack.

Description: This jack is carefully made and is provided with ample insulation between terminals. The connecting terminals are all at the panel end of the instrument and the spring contacts extend only ⅞ of an inch back from the panel. The jack is designed to mount by means of a single hole drilled through the panel. The connection terminals are in the form of soldering lugs, and are widely separated to avoid the necessity for running connection wires close together.

Usage: As a convenient means for connecting headphones or a reproducer into a circuit.

Outstanding features: Its extremely small size makes this jack invaluable in any receiver where space is limited. Workmanship and materials are first class. Connection terminals are easy to get at.

Maker: Carter Radio Co.



It's Easy to Add Water to Your Battery With This Simple Device

Name of instrument: Battery filler.

Description: This instrument consists of a moulded hard rubber tube six inches in length, to one end of which is attached a soft rubber bulb. The bulb holds approximately ½ pint of water.

Usage: For adding distilled water to the electrolyte in storage batteries.

Outstanding features: A strong, well-made device. The long, slender nozzle permits water to be added to batteries without spilling and without the necessity of removing the battery from the cabinet.

Maker: Joseph Esserman Mfg. Co.

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It's Easy For Anybody To Build With *SIMPLIFIED BLUEPRINTS*

LAURENCE M. COCKADAY has personally supervised the preparation of *Simplified Blueprints* of twelve of POPULAR RADIO'S most popular circuits. Each set consists of three *Actual Size* Blueprints; first, a Panel Pattern; second, an Instrument Layout; and third, a Picture Wiring Diagram all simplified in the fullest sense of the word because

The Panel Pattern can be laid on the panel and all holes drilled as indicated. No scaling to do and so accurate there is no danger of ruining the panel through faulty calculation.

The Instrument Layout placed on the sub-base permits you to indicate by pinpricks the exact location of every screw.

The Picture Wiring Diagram gives every instrument in exact size and position with every wire clearly indicated from one contact to the other. With no knowledge of radio symbols you can assemble every part and complete your wiring with no chance of error.

Priced at $1.00 per Set

Set No. 11—*"5-Tube Tuned Radio-Frequency Receiver with Simplified Control"* (as described in August, 1925, issue of POPULAR RADIO).

Set No. 12—*"8-Tube Superheterodyne with Single Control"* (eight tubes, two straightline variable condensers, as described in October, 1925, issue of POPULAR RADIO).

Set No. 14—*"The LC-26 Broadcast Receiver"* (as described in December, 1925, issue of POPULAR RADIO).

Set No. 15—*"The Orthophase Receiver"* (a circuit development using a new principle in radio-frequency amplification, making a receiver with great sensitivity, combined with sharp tuning and ease of operation, as described in February, 1926, issue of POPULAR RADIO).

Set No. 16—*"The S-C All Wave Receiver"* (equipped with inter-changeable coils so that it has practically an unlimited wavelength range, covering all wavelengths from 50 to 550 meters, as described in March, 1926, issue of POPULAR RADIO).

Set No. 18—*"The Improved Raytheon Power-Pack"* (as described in the May, 1926, issue of POPULAR RADIO).

Set No. 19—*"The New Home Receiver"* (three tubes, two stages of radio-frequency amplification with crystal detector, as described in June, 1926, issue of POPULAR RADIO).

Set No. 21—*"The Improved Browning-Drake Receiver"* (as described in the August, 1926, issue of POPULAR RADIO).

Set No. 22—*"The LC-27 Broadcast Receiver"* (as described in the October, 1926, issue of POPULAR RADIO).

Set No. 23—*"The LC-Senior Power-Pack"* (as described in the November, 1926, issue of POPULAR RADIO).

Set No. 24—*"The LC-Intermediate Power-Pack"* (as described in the December, 1926, issue of POPULAR RADIO).

Set No. 25—*"The LC-Junior Power-Pack"* (as described in the January, 1927, issue of POPULAR RADIO).

Full constructional and parts details for these Receiving Sets will be found in the issue of POPULAR RADIO indicated. Back issues of POPULAR RADIO will be furnished at the rate of 35c a copy

Popular Radio

627 West 43d Street **Dept. 44** **New York City**

POPULAR RADIO, Inc., Dept. 44
627 West 43d St., New York City

Date.....

Enclosed is my remittance of $....., for which kindly send me Blueprint Set (s) consisting of Panel Pattern, Instrument Layout and Wiring Diagram as checked below:

☐ Set Number 11	☐ Set Number 16	☐ Set Number 22
☐ Set Number 12	☐ Set Number 18	☐ Set Number 23
☐ Set Number 14	☐ Set Number 19	☐ Set Number 24
☐ Set Number 15	☐ Set Number 21	☐ Set Number 25

Name.....

Address.....

City..... State.....

DEALERS

Write for terms on these fast selling Blueprints.

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A NEW FREE SERVICE To SET BUILDERS

POPULAR RADIO
Laboratory tested sets are easier to build if you use our FREE PICTURE WIRING DIAGRAMS with our

Just Tear this Advt. out

Let Us Quote You on—

Gentlemen: Without obligation, send me full information and prices on sets which I have marked X.

☐ Univalve Receiver as specified
☐ Cockaday's LC-27
☐ Improved Browning-Drake
☐ S-C, Single control. All Wave
☐ Hammarlund-Roberts Hi-Q
☐ PORTABLE TEST BOARD
☐ QUALITY AMPLIFIER
☐ SHORT EQUIPMENT

I enclose $1.00 for Simplified Blueprints

SIMPLIFIED FULL SIZE BLUEPRINTS

A radio set constructed from one of our kits is not only easier for the experimenter to build, but its appearance both inside and out, makes it more valuable to you.

Every Stamford Shop Kit includes a set of full size simplified Blueprints. An instrument layout shows every part in exact size and position. A picture-wiring diagram shows where and how to connect each wire. By following the wiring plan of the designer your set cannot fail to perform more efficiently.

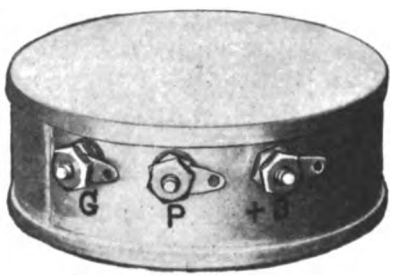
Our Kits contain everything needed to complete the set, down to the last piece of buss bar and screw. Every panel is machine-drilled and artistically decorated.

Check opposite the sets you are interested in for complete data and prices of kits and parts.

Write for Prices on
Browning-Drake New Receiver
as described in this issue

Diamond-of-the-Air 6-TUBE KIT—
Complete Parts $37.50
Licensed under Armstrong Patent No. 1,113,149

RADIO SHOP OF STAMFORD
20 Worth St. Stamford, Conn.



Shielded Tuned Radio Transformer, No. 30

SICKLES
Diamond-Weave Coils

The new Sickles Shielded Tuned Radio Transformer prevents both outside and local interference. It is remarkably compact, sharp-tuning, sturdy.

Sickles Diamond-Weave Coils have established an enviable reputation for low distributed capacity, low dielectric losses, and large range of frequency with small variable capacity.

The ideal coil for the Na-Ald Localized Control Tuning Unit and the Na-Ald Truphonic Assembly.

There are Sickles Diamond-Weave Coils for all leading circuits.

THE F. W. SICKLES CO.
134 UNION STREET
SPRINGFIELD :: MASS.

No.	Coil Prices	
30	Shielded Transformer	$2.00 each
24	Browning-Drake	7.50 set
18A	Roberts Circuit	8.00 set
25	Aristocrat Circuit	8.00 set

In the World's Laboratories

(*Continued from page 369*)

this degree of speed. He has demonstrated, however, that the quantity of electricity emitted from the sensitive photoelectric metal is proportional, even for the shortest light-flashes which he has obtained, to the lengths of these flashes. Additional experiments are proposed, using still shorter flashes obtained by the passage of pencils of light through a shutter mechanism which will interrupt the light at a rapid rate, separating it into a succession of very short flashes.

A similar principle, although employing much less rapid interruption, was used recently by Dr. Norman Hilberry, Mr. C. A. Johnson and Dr. Ann Hepburn, of New York University, in constructing a new musical instrument, christened the photoelectric organ, which the Editor of this Department had the honor to demonstrate before a recent meeting of the New York Electrical Society. In this apparatus a beam of light from a small lamp was interrupted at audio frequency by passing it through a series of holes bored in a rotating metal disk. The light-beam, carrying this musical frequency, then fell upon a sensitive photoelectric cell, the electrical impulses so produced being amplified in the usual fashion and transmuted into sound by a conventional loudspeaker system.

*"Ballistic Characteristics of the Photoelectric Cell," by F. E. Null. *Journal of the Optical Society of America* (Menasha, Wisc.), volume 14, pages 73-85 (January, 1927).

Radio Power From the Ocean?

THE distinguished French engineer, M. Georges Claude, well known as a pioneer in the investigations of gas compression which have led to the production of oxygen, hydrogen, neon and still rarer gases from atmospheric air, startled the scientific world a few months ago by announcing his conviction that large amounts of useful power might be obtained from the water of the sea.*

M. Claude begins his argument from the admitted fact that the water at the bottom of the deep ocean is always cold in all parts of the world, seldom rising more than a few degrees above the freezing point. On the contrary, the surface waters of the oceans in tropical regions are usually warm. This condition is maintained, oceanographers know, by means of a slow circulation of polar water southward along the bottoms of the oceans and of tropical water northward along the ocean surfaces.

M. Claude proposes that the hot surface water of the tropical ocean should be exchanged with the cold water in the greater depths; or, what is the same thing, that the cold water should be brought up to the surface to serve as the cooling agent for great vacuum condensers in which steam produced from the hotter surface water, also in vacuum, could be condensed.

This process is merely one variety of heat engine, quite analogous to the familiar steam engine. In the theory of such heat engines heat may be treated, as all engineers know, as though it were a substance. The heat contained in the surface waters of the ocean would be transferred, by some combination of mechanisms, to the cold water of the deep ocean. During this transfer the engineers could arrange to take toll of the heat, procuring a fraction of it in the form of electric power or other useful energy.

The theory is unquestionable. There seems little doubt that an apparatus could be constructed actually to obtain useful power in this way. The only fly in the ointment is the bulk and cost of the machinery. The reputation of M. Claude among engineers is so high that his proposals have attracted enormous attention all over the world. While none of his critics are willing to say definitely that the procedure is impossible, it must be admitted that the sum total of engineering comment is adverse rather than favorable. It is admitted by the best friends of the proposal that the condensers, boilers and other machines necessary would run to enormous mag-

*"On the Utilization of the Thermal Energy of the Sea," (in French) by Georges Claude and Paul Boucherot. *Comptes Rendus de la Académie des Sciences* (Paris), volume 184, pages 929-933 (spoken November 15, 1926; printed as of November 22, 1926). See also: "On the Utilization of the Energy of Natural Hot Waters" (in French), by P. Villard. The *same*, volume 184, pages 1001 (November 29, 1926); "On the Utilization of the Thermal Energy of the Sea" (in French). The *same*, volume 184, pages 1005-1006 (November 29, 1926). The first paper of MM. Claude and Boucherot was reprinted in *La Nature* (Paris), number 2748, pages 357-359 (December 4, 1926).

Underwood

POWER FROM THE SEA

M. Georges Claude, distinguished French inventor, proposes to get power from the tropical oceans. This might be practicable if power transmission by radio were already a possibility.

HOW TO MIX WITH THE BEST PEOPLE

You, too, can move in the best circles!

THIS is the story of Angela Apple and how she became the toast of the town (*name on request*) overnight. It seems a travelling salesman came to their house one night—no that isn't the story. We'll rub it out and start all over! Angela was worried no end. She suffered from chill-blains, stuttering, fallen arches, plain face and an Inferiority Complex—1927 sport touring.

None of the gay young bloods would come near her house in spite of the fact that her father was a famous bootlegger. That will give you a rough idea of how hot Angela was. She was so popular the boys called her "Poison Ivy."

She even tried luring them with the old man's rare vintages of 1926, but after taking a swallow of one of her concoctions, the sheiks would grow green around the gills and go right through the parlor window.

In this way, she collected quite a few overcoats and hats and even shoes, which she decided to sell. After arguing with the big-hearted old clothes man one entire morning she took the dollar and went downtown, and as she passed a bookstore window she glanced in and what do you think she saw! You guessed it! A copy of *"Here's How!"* by Judge, Jr!

Well, to get down to the coupon, she went right in and bought it and **THAT NIGHT** she 'phoned all the boys to come over because her father was giving away bottles of gin. And did the boys come? Well, you can bet your sweet life they did, Gentle Readers!

Angela mixed them some snifters from *"Here's How!"* and about five o'clock in the morning the old man called down and wanted to know if the gang was ever going home!

And every night now Angela's house is crowded with young sheiks from all over the state and she's the envy of every girl in town!

JUDGE, JR.
Department P. R.
627 West 43rd Street, New York.

DEAR JUNIOR:

I want to be popular, too, and mix with the best people. Here's a dollar for my copy of *"Here's How!"*

.....

.....

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FREE PARTS
for the new "Town & Country" Receiver

If you want to build your own set, here is your opportunity to secure FREE all the parts you need for this New "Town & Country" Receiver. Call on all your radio friends, and on anyone who has a set and tell them of the many special features of POPULAR RADIO.

These liberal offers will make it possible for you to secure an order from every one you call upon. For each subscription with remittance you send us you will receive credits as per the following scale

POPULAR RADIO

4 Months	**for**	**$1.00**	**counts**	**16**	**credits**
6	"	1.50	"	25	"
8	"	2.00	"	33	"
12	"	3.00	"	50	"
24	"	5.00	"	75	"

Send us the full amount collected with names and addresses of subscribers and tell us the parts your credits entitle you to and we will send them to you. If the subscriptions you secure do not give you enough credits for the parts you want, we will allow you to purchase credits at the rate of 3 cents each. *Example:* With (7) seven 1-year subscriptions (350 credits) and 36 cents additional in cash you may have a Silver-Marshall antenna coil, No. 110-A, a Silver-Marshall type No. 340, midget variable condenser, 3 Electrad by-pass condensers and an Amsco potentiometer for which you need 362 credits.

If the parts you want are not listed in this advertisement, we are prepared to supply them. Let us know what you want and we will tell you how many credits you will need.

On page 399 are described POPULAR RADIO'S Simplified Blueprints. You can have any set of prints you want for only 40 credits. You may also secure a copy of "How to Build Your Radio Receiver" described on page 413 for 60 credits.

CREDITS Needed for Parts Required for the new "TOWN & COUNTRY" RECEIVER

(Described and illustrated in the July, 1926, issue of POPULAR RADIO.)

Quantity	Item	Credits
1	Silver-Marshall antenna coil, No. 110-A, equipped with coil socket No. 515	140
1	Silver-Marshall oscillator coil, No. 111-A, equipped with coil socket No. 515	140
1	Silver-Marshall type No. 340 midget variable condenser, .000025 mfd. equipped with knob	60
2	Silver-Marshall No. 210 long wave radio-frequency transformers for use with No. 199 type vacuum tubes @ 240	480
1	Silver-Marshall No. 211 long wave radio-frequency transformer for use with No. 199 type vacuum tube and equipped with calibrated fixed shunt condensers	240
2	Samson Uniform frequency variable condensers, No. 67, .00035 mfd. @ 350	700
2	Dubilier Fixed Condensers, .00025 mfd. with grid leak clips, 640 G @ 20	40
1	Dubilier Fixed Condenser, .002 mfd.	16
3	Electrad by-pass condensers (in cans) .5 mfd. @ 34	102
1	General Radio audio-frequency transformer No. 285, 1-6 ratio	240
1	General Radio audio-frequency transformer, No. 285, 1-2 ratio	240
3	General Radio Miniature Jacks, No. 274-J with three miniature plugs, No. 274-P @ 12	36
1	Yaxley Jack No. 2-A	24
1	Yaxley Jack No. 1	20
1	Yaxley Battery Switch No. 10	20
1	Ansco 20 ohm rheostat with knob	50
1	Ansco potentiometer, 400 ohms with knob	60
2	Daven Grid Leak Resistors, 2 megohms @ 20	40
7	Benjamin UX type sockets No. 9040 @ 30	210
1	Precise Condenser Shaft Extension Bushing Connector No. 744	24
1	Jewell "A" and "B" battery voltmeter, pattern No. 135-B panel mounting and equipped with push button	360
2	Walbert "Univernier" Dials 4 in. in diameter, scale reading left to right @ 50	100
1	Eveready No. 703, 4½ volt flashlight battery	16
Hardwood Baseboard, 8½ by 19 inches		20
Composition binding post strip		10
Composition Mounting Block for loop plugs		6
Composition Mounting Block for multi-plug socket		6
Composition Panel, 7 by 20 inches		72
2 Brass Brackets		8
7 Eby Binding Posts		42
Soldering Lugs and Screws		10
Total		3532

Write for List of Free Parts for Other Popular Radio Receivers

POPULAR RADIO
Department 41B
627 West 43d St. New York City

nitude. How these could be placed safely on any kind of floating power-house does not appear. Furthermore, the transmission of the power produced to regions where power is in demand would be enormously troublesome.

Here is where radio might enter the matter. If radio transmission of power ever becomes practicable (which at present seems more than doubtful) a more favorable face might be placed on M. Claude's proposal. From the viewpoint of present radio engineering, however, the thing most needed is not a great source of power produced in units of enormous magnitude and equally enormous output, but of some new and cheap way of obtaining power in small units.

In spite of the great development in recent years of apparatus by which radio receivers may be operated from the usual power lines, it must be admitted that the essential problems of power for radio are still unsolved.

The Sun, but Not Weather, Affects Radio

ONE of the most interesting papers presented before the recent meeting of the Institute of Radio Engineers, in New York City, was that of Mr. Greenleaf W. Pickard, on the correlation of radio reception with certain terrestrial disturbances.*

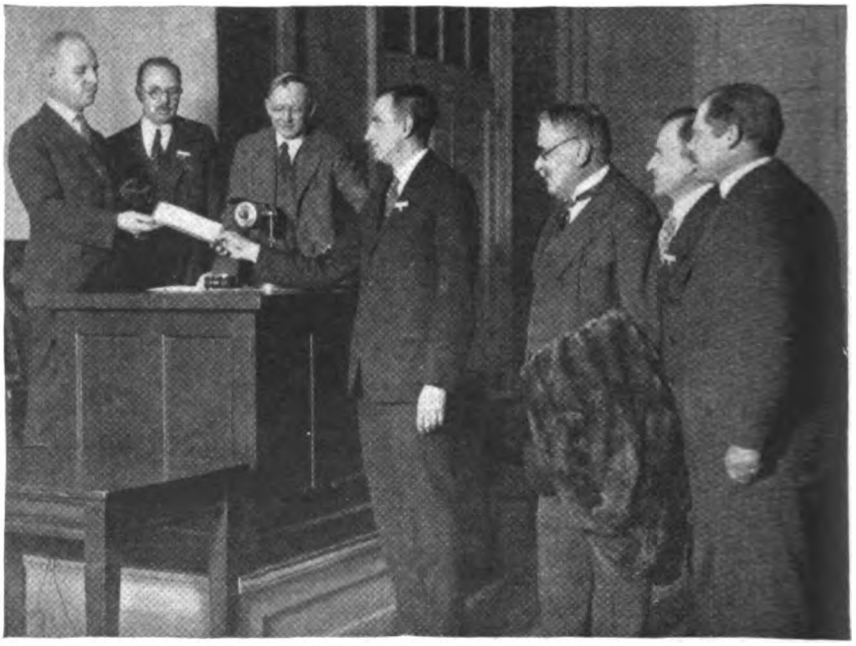
*"The Correlation of Radio Reception with Solar Activity and Terrestrial Magnetism," by Greenleaf W. Pickard. For publication in the *Proceedings of the Institute of Radio Engineers* (New York), cited from advance proof released at the meeting of the Institute, New York City, January 10, 1927.

It is well-known to the radio public that Mr. Pickard has been engaged for several years on the measurement of the strength of radio waves coming from various transmitters and received in his laboratory at Newton Centre, Massachusetts. The work reported at the New York meeting included the reception records made in this way on the transmissions of Station WBBM, at Chicago.

Mr. Pickard was unable to identify any exact relation between the weather at Newton Centre or at Chicago and the variations of radio reception. It was possible, however, to correlate the conditions of radio propagation quite definitely with the existence of solar disturbances, as exemplified by magnetic storms, Auroras, and similar occurrences. In discussing Mr. Pickard's paper, Dr. M. I. Pupin, of Columbia University, agreed with this diagnosis of solar effects on radio, an agreement which Dr. Pupin had already expressed a few weeks before in his presidential address to the American Association for the Advancement of Science, already noted in this Department.

One of Mr. Pickard's evidences for the conclusion that factors which cause good or bad reception are not controlled by local weather is the fact that these radio conditions seem never to be local.

"I have found," Mr. Pickard said, "that a bad night for reception in Newton Centre is in general a bad night anywhere in the United States. And I have also found that European reception of distant broadcast stations agrees re-



Underwood

A GROUP OF RADIO'S "ARISTOCRACY OF BRAINS"

Dr. Ralph Bohn (in front of the desk) is receiving the Liebman Memorial Prize of the Institute of Radio Engineers from Mr. Donald McNicol, former President of the Institute. Dr. Bohn himself is the new president. At Mr. McNicol's left is Mr. John V. N. Hogan, Contributing Editor of POPULAR RADIO. *Next to him is Mr. R. H. Mariott. Behind Dr. Bohn are Professor Michael I. Pupin, of Columbia University; Mr. L. E. Whittemore and Mr. E. F. W. Alexanderson, well-known inventor and radio engineer of the General Electric Company.*

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markably well with my measurements of WBBM."

The solar effects on radio conditions; whether these effects be due to ether waves, to electrons, or (as Dr. Pupin suggested) to the positively-charged nucleii of atoms which we call alpha particles; are evidently worldwide, which is something that cannot be said of weather.

Another of Mr. Pickard's paragraphs deserved to be nailed up as a motto in the laboratory of every scientist.

"The secrets of this universe," he said, "yield rather to observation than to pure speculation. When we have a sufficiency of the right kind of data we can form suitable explanations; until then we are groping in the dark."

Definitely as this statement applies to the present more or less useless theorizing about the relations between radio and weather, no fault can be found with the many experimenters who are examining weather facts and endeavoring to obtain the kind of observations which Mr. Pickard suggests. It is worth while to call to the attention of these experimenters a booklet written by Professor Eugene Van Cleef, of Ohio State University, and issued by the Taylor Instrument Companies of Rochester, New York.†

†"The Weather for Radio Listeners, Broadcasters and Others," by Eugene Van Cleef. Published by the Taylor Instrument Companies, Rochester, New York, October, 1926, 34 pages. Some of Professor Van Cleef's ideas are outlined in his article "How a Low Barometer Affects Radio," *Radio Broadcast* (Garden City, N. Y.), volume 10, pages 152-153 (December, 1926).

The Electron Inspires a Song

SIR RICHARD PAGET, the distinguished English physicist, whose sense of humor was evidenced some time ago by his success in producing artificial speech by manipulating his two hands clasped together, recently amused the members of the Physical Society of London with a song, three verses of which follow:*

There was a jolly electron—alternately bound and free——
Who toiled and spun from morn to night, no Snark so lithe as he;
And this the burden of his song for ever used to be—
"I care for nobody, no, not I, since nobody cares for me.

Though Crookes at first suspected my presence on this earth,
'Twas J. J. Thomson found me—in spite of my tiny girth.
He measured first the "e by m" of my electric worth;
I love J. J. in a filial way, for he it was gave me birth!

* * *

So whether I rest as static charge, or rove in the ether free,
Or whether I settle in nuclear state, perched up on a proton's knee,
Or whether I spin my quantum yarns, in a spectroscopic key,
I'll love the "Physicals" all the time, since all of 'em dote on me.

*"The Jolly Electron," by R. A. S. Paget. *Nature* (London), volume 118, page 885 (December 18, 1926).

First in the Field Specializing in Cockaday Kits

S. HAMMER RADIO CO., 303 Atkins Ave. Brooklyn, New York

Cockaday Sets Now Made Easier to Build by Our New "Ready-to-Wire" Plan

50% of Your Time, Work and Worry SAVED!

All you need do is to connect bus-bar according to diagram, solder and your set is finished. These Kits are sent to you completely mounted, and assembled on a Veneered Mahogany baseboard and genuine bakelite panel, drilled and engraved. Genuine parts used as listed below; exactly as used in Mr. Cockaday's Laboratory Model. COMPARE OUR OFFER!

LC-27 BROADCAST RECEIVER

SENIOR AND INTERMEDIATE POWER PACKS

1 Hammarlund mid-line dual condenser, .000275 mfd.	$ 7.50
1 Hammarlund mid-line single condenser, .000275 mfd.	4.65
1 Precision Duo-Octoform coil set comprising one antenna coupler and two interstage couplers	10.50
1 Amertran De Luxe first-stage transformer	10.00
1 Amertran De Luxe second-stage transformer	10.00
1 Amerchoke #854	6.00
1 Dubilier or Tobe 4 mfd. Filter condenser.	5.50
1 Dubilier filter condenser, .1 mfd.	.60
1 Mar-Co illuminated control scale 0 to 100	3.50
2 Mar-Co small controls, scale 0 to 50 and 50 to 0	1.50
1 Carter Battery Switch	.65
1 Samson radio-frequency choke coil #85	$1.50
3 Aerovox, mica fixed condensers, .00025 mfd	1.05
1 Durham or Daven Resistor 4 meg	.50
1 Lynch Grid Leak Mounting	.35
1 Cartet Gem Jack	.25
1 Carter variable resistance, 0-10,000 ohms.	2.00
12 Eby binding posts	1.80
5 Benjamin UX Sockets	3.75
1 Amperite No. 1	1.10
Mechanical Kit, consisting of aluminum shields, binding post strip, decorated panel and Tait brackets	12.50

READY-TO-WIRE KIT PRICE $85.20

LC-27 SENIOR POWER PACK KIT $65.20

LC-27 INTERMEDIATE POWER PACK KIT $47.50

SILVER SHIELDED SIX KITS *In Stock Now!*

HAMMARLUND-ROBERTS HI-Q KITS

Authorized Headquarters for the

NEW! KENNETH HARKNESS KH-27 RECEIVER
BROWNING-DRAKE RECEIVER

The Above Kits Can Also Be Obtained Completely Wired to Specifications

Write for our interesting special circular which we have prepared on the LC-27 Receiver and above Kits

DEALERS: WRITE FOR SPECIAL DISCOUNTS

The

POPULAR RADIO Atlas *and* Log

will give you a list of all the NEW Broadcasting Stations with wavelengths and other necessary information

A Complete Atlas and Station Log

The "POPULAR RADIO International Radio Atlas and Log" will supply you with full information regarding broadcasting stations of the United States and Canada.

This most useful and practical Atlas consists of 16 pages, size 12" x 15", printed on good paper, from clear type in two colors and contains a complete series of double page maps, including—The World—The United States—Canada—North and South America, showing location of principal broadcasting, leading commercial and governmental radio stations.

SPECIAL FREE OFFER

You may have a copy of the "POPULAR RADIO International Radio Atlas and Log" free, with POPULAR RADIO for (8) eight months

For Only $2.00

Pin $2.00 in bills to the coupon below.

If you are a subscriber to POPULAR RADIO your subscription will be extended eight months.

Date.....

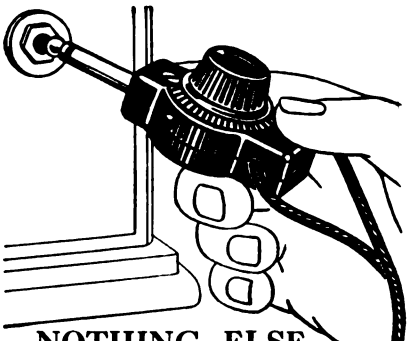
POPULAR RADIO, Dept. 42A,
627 West 43rd St., New York City.

Enclosed is my remittance of $2.00 for which you are to enter my subscription (extend my subscription) for (8) eight months for POPULAR RADIO and send FREE a copy of the "POPULAR RADIO International Radio Atlas and Log."

Name .....

Address.....

City.....State.....



NOTHING ELSE LIKE IT!

HERE is a simple radio control—*the Centralab Modu-Plug*—that is unique even in a field where phenomenal developments are common.

Provides smooth, noiseless control of tone and volume *direct at the plug* with the set operating at full efficiency. Without adjusting tuning dials or other controls, you can regulate volume from a whisper to maximum simply by turning the little knob on this plug. "Reduces static interference—clarifies tone." Replaces the ordinary loud-speaker plug.

$2.50 at your dealer's, or mailed direct on receipt of price.

CENTRAL RADIO LABORATORIES
17 Keefe Ave., Milwaukee, Wisconsin
Manufacturers of variable resistances for all radio circuits

Centralab

The Senior Six
ELKAY
With Truphonic Audio
Renders in true color all the tones of the scale from bass to treble. Brings in the voice in natural, human quality. Complete shielding for quiet tone background. Centralized control, but with fine adjustment for selectivity.
POPULAR RADIO has tested and approved the Senior Six Elkay, and editorially has fully described this receiver.
NOW READY: New Junior Six ELKAY; an improved T. R. F. receiver designed thruout on Elkay standards, but at a price of $80.
Jobbers, Dealers: Write for Elkay franchise.
The Langbein-Kaufman Radio Co.
Dept. P, 62 Franklin St., New Haven, Conn.

Build the
"Town and Country"
Portable Receiver
with
Simplified
Blue Prints

The "Town and Country" Portable Receiver, developed by the POPULAR RADIO LABORATORY and described in the July, 1926, issue, marks a decided advance in portable receiver design. While not a "vest pocket" receiver, the new "Town and Country" is small enough to be taken along on a motor boat or train trip. Efficiency has not been sacrificed for the sake of compactness.

The receiver uses six UX-199 tubes and one UX-120 power tube. Operating on a loop, tone quality is guaranteed by the use of a fundamentally correct circuit, high-class transformers and cone-type speaker.

The "Town and Country" Portable Receiver is mounted in a special mahogany cabinet with a drop front and is equipped with a carrying handle. All equipment, including the folding loop, cone loud-speaker, batteries and connecting cable, is installed in a suitcase. Connections from the equipment to the set are made by means of jacks and plugs.

By using POPULAR RADIO Blue Prints in building your "Town and Country" receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory model.

If your local dealer cannot supply you with Blue Prints of this set, they will be sent postpaid upon receipt of $1.00 per set.

POPULAR RADIO
Service Bureau 44-D
627 W. 43rd St., New York City

Ether Waves as Old as the Dinosaurs

A FEW months ago in this department were described the investigations of Professor Harlow Shapley, of Harvard University, leading to the conclusion that some of the faint spiral nebulas visible in photographs made through great telescopes lie at such enormous distances from the earth that the light rays which they send us need over ten million years to make the journey.*

Now comes Major Edwin P. Hubble, the well-known astronomer of Mount Wilson Observatory, with a still more astonishing estimate. He has located some star-groups, also of the spiral nebula type, which are at a distance, he estimates, of about 140,000,000 light years, fourteen times as far away as Professor Shapley's group. The universe does not long remain, any more, of one determined size. Scarcely is the ink dry on the report of one widening discovery than another comes along to make our knowledge of space still wider.

It is interesting to consider the age of the ether waves which come to us from those very distant islands in space, with which rays Dr. Hubble took the photographs to make his estimate. One hundred and forty million years ago there was no creature at all like man on earth; there were not even apes. The earth was in the possession of great reptiles of the dinosaur type, although the best days of this remarkable group of beasts were already passing. There existed some tiny cat-like and weasel-like creatures, scurrying about beneath the feet of the bulky reptiles. These were our ancestors. In the time that has passed since Dr. Hubble's light rays left the atoms that produced them and started out toward the earth, there has been time for the entire evolution of mankind, from a weasel to us.

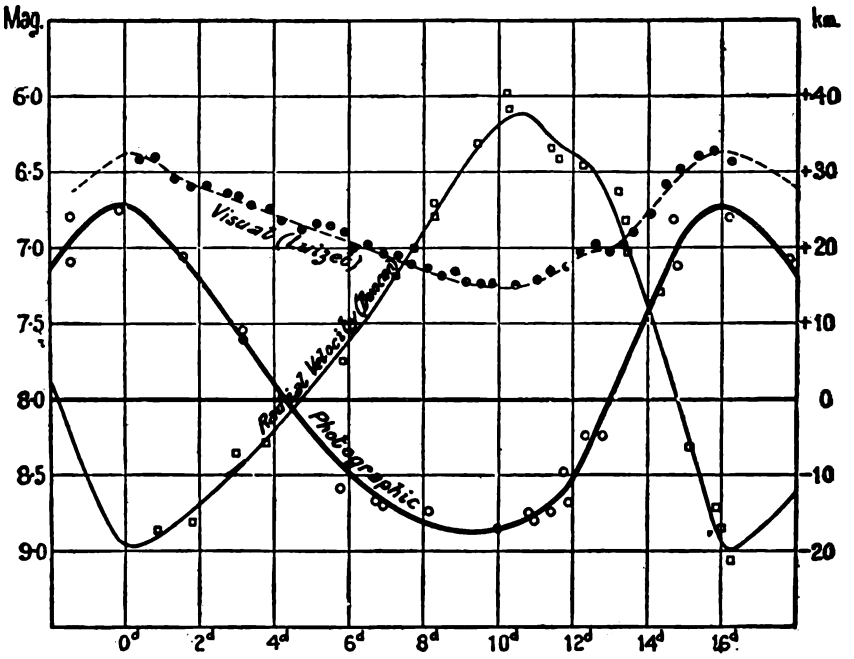
*"Ether Waves Ten Million Years Old," POPULAR RADIO for October, 1926, pages 592, 594-595.

Static in Panama

ADDITIONAL determinations of the directions with which atmospheric disturbances arrive at the radio stations at Panama are reported in a recent note by Dr. L. W. Austin, of the United States Bureau of Standards.* Dr. Austin's conclusions are that during the dry season, roughly between January and April, most of the atmospherics come from the high Andes Mountains in South America. In midsummer, on the other hand, there is a great deal of disturbance from the lower-altitude regions of Central America and Mexico, also much local disturbance from the immediate neighborhood of the stations.

*"Direction Determination of Atmosphere Disturbances on the Isthmus of Panama," by L. W. Austin. *Journal of the Washington Academy of Sciences* (Baltimore, Md.), volume 16, pages 457-460 (October 18, 1926).

X CYGNI



Courtesy of Dr. François C. Henroteau

CURVES WHICH FIX THE AGE OF LIGHT RAYS

These curves indicate the variations of the star named X Cygni, one of the variable stars of the Cepheid class, which stars astronomers use to determine the remoteness of nebulas like those which Major Edwin P. Hubble has found to be sending us light rays over one hundred and forty million years old. The "period" of such a variable star is given by the time between each two successive high points of the curves marked "visual" and "photographic." This period corresponds to the true brightness of the star.

Wanted: Facts About Sparks

ALTHOUGH the kind of electricity conventionally called "frictional electricity" was the first kind to be discovered and remained for centuries the only kind which men knew about at all, there are still many facts concerning this kind of electricity of which we remain profoundly ignorant.

For example, there is no certain information about which way the electrons jump when one substance is rubbed on another.

If you stroke the back of a cat with a rubber rod (assuming the cat to permit such a familiarity) it may be that the electrons will jump from the cat to the rod, so that the latter becomes negatively electrified and the cat positively. On the other hand, there appear to be occasions—or kitties—which produce the transfer in the reverse direction; yielding a positive rod and a negative cat. No one knows just what conditions of cat, rubber, air or something else cause the direction of the electron jumps to be reversed in this erratic fashion.

That these matters furnish excellent opportunities for amateur experimenters to work advantage to science without great expense for apparatus is suggested by some interesting observations recently published by Mr. P. E. Shaw, of the University College, Nottingham, England.* Avoiding the somewhat complicated conditions introduced when one of the experimenters is a cat, Mr. Shaw confines his present communication to the electrifications produced when two substances of the same kind—in this case, two hard rubber rods—are rubbed or struck together. Even in this instance the results are by no means simple. The direction of the electrification depends, Mr. Shaw finds, upon the condition of the surfaces of the two rods and upon many other circumstances which would be likely to be considered negligible by experimenters not in the secret.

In past centuries many of the greatest advances of science have resulted from the researches of amateurs, working with little equipment and animated merely by the desire to find out the truth and to have fun while doing so. The complexity and expense of great modern laboratories now deter many amateurs from attempting scientific work. What would be the use, they think, of competing with such rich, powerful and well-staffed institutions? Their timidity is not to the advantage of science. A multitude of researches might be undertaken with optimism and with no more equipment than the furniture of a kitchen; with, for example, a piece of discarded hard-rubber radio panel and the family cat.

*"The Electrical Charges from Like Solids," by P. E Shaw. *Nature* (London), volume 118, pages 659-660 (November 6, 1926).

FREE PARTS

for the

"LC-27 Broadcast Receiver"

If you want to build your own set, here is your opportunity to secure FREE all the parts you need for the LC-27 Broadcast Receiver. Call on all your radio friends, and on anyone who has a set and tell them of the many special features of POPULAR RADIO.

These liberal offers will make it possible for you to secure an order from every one you call upon. For each subscription with remittance you send us you will receive credits as per the following scale:

POPULAR RADIO

4 Months	**for**	**$1.00**	**counts**	**16**	**credits**
6	**"**	**"**	**1.50**	**"**	**25**	**"**
8	**"**	**"**	**2.00**	**"**	**33**	**"**
12	**"**	**"**	**3.00**	**"**	**50**	**"**
24	**"**	**"**	**5.00**	**"**	**75**	**"**

Send us the full amount collected with names and addresses of subscribers and tell us the parts your credits entitle you to and we will send them to you. If the subscriptions you secure do not give you enough credits for the parts you want, we will allow you to purchase credits at the rate of 3 cents each. Example: With (7) seven 1-year subscriptions (350 credits) and $1.50 additional in cash you may have an AmerTran De Luxe first-stage radio-frequency transformer, for which you need 400 credits.

If the parts you want are not listed in the advertisement, we are prepared to supply them. Let us know what you want and we will tell you how many credits you will need.

On page 399 are described POPULAR RADIO's Simplified Blueprints. You can have any set of prints you want for only 40 credits. You may also secure a copy of "How to Build Your Radio Receiver" described on page 413 for 60 credits.

CREDITS Needed for Parts Required for the LC-27 BROADCAST RECEIVER

(Described and illustrated in the October, 1926, Issue of POPULAR RADIO.)

Quantity	Item	Credits
1	Hammarlund mid-line dual condenser, .000275 mfd	300
1	Hammarlund mid-line single condenser, .000275 mfd	186
1	Precision Duo-Octaform coil set, one antenna coupler and two inter-stage couplers	420
1	AmerTran De Luxe first-stage transformer	400
1	AmerTran De Luxe second-stage transformer	400
1	Amerchoke No. 854	240
1	Dubilier No. 902 filter condenser, .4 mfd	220
1	Dubilier No. 907 Filter Condenser, .4 mfd	24
1	Mar-Co illuminated control, scale 0 to 100	140
2	Mar-Co small controls for LC-27	60
1	Carter battery switch	26
1	Samson radio-frequency choke coil No. 85	60
3	Averovex mica fixed condensers, .00025 mfd	42
1	Durham resistor, 4 megohms	20
1	Lynch grid leak mounting	14
1	Carter Gem Jack	10
1	Carter resistance, 0-10,000 ohms	80
10	Eby binding posts	60
5	Benjamin UX sockets	150
1	Amperite	44
Mechanical Kit consisting of aluminum shields, binding post strip, decorated panel and Tait brackets		500
	Total	3408

Write for List of Free Parts for Other Popular Radio Receivers

POPULAR RADIO

Department 41A

627 WEST 43d STREET NEW YORK CITY

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Build Your LC-27 Receiver

with the aid of

Popular Radio

SIMPLIFIED

Blue Prints

Easy, Quick and Accurate

POPULAR RADIO believes that this new circuit, which is the outstanding contribution of Laurence M. Cockaday to the experimental set-builder for this year, constitutes not only one of the most important advances that has so far been made in the radio art, but that it is distinguished by a tonal quality—particularly in the lower registers—that is unsurpassed.

This receiver embraces the 14 points of an ideal radio receiver to meet the demands of the average man's requirements.

1. A quality of reproduction that is as nearly perfect as possible;
2. A cabinet designed to blend harmoniously with the finest surroundings;
3. Consistently good performance with a minimum of care and attention, once the set is installed;
4. A tuning control so simple that any one may operate the set without special instruction;
5. A selectivity adequate to eliminate interference from stations on adjoining wavelengths;
6. An ability to operate on any type of outdoor antenna or with no antenna at all;
7. A capacity to operate on house current or batteries, as desired;
8. Adequate shielding of parts;
9. A power amplifier and output filter to supply ample volume without distortion;
10. A construction that provides for the use of nationally known tubes and parts that are easily obtainable in any locality;
11. A non-regenerative circuit;
12. A simple construction with a minimum of adjustments;
13. A sensitivity adequate to provide good reception of distant programs;
14. A fool-proof construction.

By using POPULAR RADIO Simplified Blueprints in building your LC-27 Receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory model (see page 399).

If your local dealer cannot supply you with Blueprints of the LC-27 Receiver, they will be sent post-paid upon receipt of $1.00.

A full description of this Receiver, with detailed directions for building, was published in the October, 1926, issue of POPULAR RADIO. Send 35 cents for a copy.

We also have Blueprints of The LC-Senior Power-Pack, The LC-Intermediate Power-Pack and The LC-Junior Power-Pack which were designed to operate The LC-27 Receiver.

POPULAR RADIO

Service Bureau 44-B

627 West 43rd Street **New York City**

The obverse of the medal; the original is two-and-one-half inches in diameter.

The Popular Radio Medal *for* Conspicuous Service

TO every radio amateur, to every amateur experimenter and broadcast listener, who is instrumental in alleviating human suffering or saving human life, directly through the medium of radio, recognition will hereafter be extended in the form of a medal that shall be known as "The Popular Radio Medal for Conspicuous Service." This medal is unique within the realms of radio, in that it shall be awarded not for scientific achievement or invention, but for service to humanity.

To insure a fair and unbiased consideration of all claims, a Committee of Awards has been appointed that includes five distinguished citizens of international fame. To assist this Committee of Awards, an Advisory Committee has been appointed that numbers among its members some of the most eminent citizens of the United States, including representatives of many of our most distinguished institutions.

The conditions under which the medal will be awarded are here specified:

1. The medal shall be known as the Popular Radio Medal for Conspicuous Service.
2. The medal shall be awarded, without discrimination as to sex, age, race, nationality, color or creed, to those radio amateurs, radio experimenters, broadcast listeners and other non-professionals through whose prompt and efficient action radio is utilized to perform an essential part in the alleviation of human suffering or in the saving of human life within the territorial confines of the United States and its possessions, or in the waters thereof.
3. The medal shall be awarded by a Committee of Awards that shall not exceed five in number. No member of this Committee shall be an employee, officer or stockholder of POPULAR RADIO, INC., nor shall any such employee, officer or stockholder have a vote in the deliberations of the Committee.
4. An Advisory Committee, which shall co-operate with the Committee of Awards and which shall be particularly charged with the responsibility of making recommendations for awards of this medal, shall be made up of men and women who, because of their interest in the public welfare or because of their connection with institutions that are consecrated to public service, are in positions to bring to the attention of the Committee of Awards the exploits of candidates who are within their own special fields of activity.
5. The medal will be awarded for services rendered since Armistice Day, November 11, 1918.
6. Recommendations for awards may be submitted to the Committee of Awards at any time and by any person. Every recommendation must contain the full name and address of the candidate, together with a detailed account of the accomplishment on which the proposed award is based, and must be accompanied by corroboratory evidence from persons who have first-hand knowledge of the circumstances and whose statements may be verified to the satisfaction of the Committee of Awards.

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FREE PARTS

for the new

Univalve Receiver

If you want to build your own set, here is your opportunity to secure FREE all the parts you need for this "Univalve Receiver." Call on all your radio friends, and on anyone who has a set and tell them of the many special features of POPULAR RADIO.

These liberal offers will make it possible for you to secure an order from every one you call upon. For each subscription with remittance you send us you will receive credits as per the following scale

POPULAR RADIO

4 Months	**for**	**$1.00**	**counts**	**16**	**credits**
6	"	"	1.50	"	25	"
8	"	"	2.00	"	33	"
12	"	"	3.00	"	50	"
24	"	"	5.00	"	75	"

Send us the fullamount collected with names and addresses of subscribers and tell us the parts your credits entitle you to and we will send them to you. If the subscriptions you secure do not give you enough credits for the parts you want, we will allow you to purchase credits at the rate of 3 cents each. *Example:* With (7) seven 1-year subscriptions (350 credits) and 90 cents additional in cash you may have 2 Cardwell Taper Plate Variable Condensers, equipped with 2 Cornell Etched Vernier Dials for which you need 380 credits.

If the parts you want are not listed in this advertisement, we are prepared to supply them. Let us know what you want and we will tell you how many credits you will need.

On page 399 are described POPULAR RADIO's Simplified Blueprints. You can have any set of prints you want for only 40 credits. You may also secure a copy of "How to Build Your Radio Receiver" described on page 413 for 60 credits.

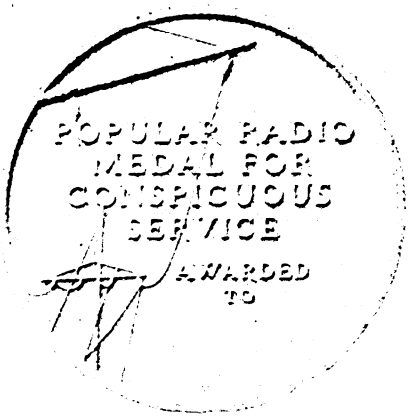
CREDITS Needed for Parts Required for the new "UNIVALVE RECEIVER"

(Described and illustrated in POPULAR RADIO.)

Quantity	Item	Credits
2	Hammerlund Autocouplers	280
2	Cardwell Taper Plate Variable Condensers, type 169-E, .00035 mfd. Equipped with 2 Cornell Etched Vernier Dials	380
1	Karas Harmonik Low-Frequency Transformer	120
1	Thordarson Low-Frequency Transformer, 2-1 Ratio	280
1	Any Approved Battery Switch (Carter Switch illustrated)	200
1	Any Approved Automatic Filament Control .25 amp. (Amperite Illustrated)	26
1	Any Approved Mica Fixed Condenser with Grid-leak Clips, .00025 mfd. (Electrad Condenser Illustrated)	44
1	Any Approved Mica Fixed Condenser, .0001 mfd. (Electrad Condenser Illustrated)	16
1	Any Approved Mica Fixed Condenser, .0005 mfd. (Electrad Condenser Illustrated)	12
1	Any Approved Grid-Leak, 4 megohms (Polymet Grid-leak Illustrated)	12
1	Any Approved Small Single-Circuit Jack. (Electrad Jack Illustrated)	10
1	Bakelite Front Panel, 7 x 15 x 3–16 inch	16
1	Hardwood Sub-base, 7 x 14 x ⅝ inch	100
1	Bakelite Binding-post Strip, 1 x 9 x 3–16 inch	20
7	Any Approved Binding Posts, marked Ant., Grnd., A Minus, A Plus, B Minus, B Amp. Plus, B Amp. Plus, respectively (Eby Binding Posts Illustrated)	12
2	Small Brass Brackets	42
1	Benjamin Vibrationless Socket	4
		30
	Total	1598

Write for List of Free Parts for Other Popular Radio Receivers

POPULAR RADIO
Department 41
627 West 43d St. New York City



The reverse; the name of each recipient will be engraved in the space provided.

7. The medal will be awarded to as many individuals as qualify for it and at such times as the Committee of Awards may authorize.
8. All considerations not specified herein shall be left to the discretion of the Committee of Awards.

All communications to the Committee of Awards may be addressed to—

The Secretary of the Committee of Awards, POPULAR RADIO Medal for Conspicuous Service, 627 West 43rd Street, New York.

The Committee of Awards

HIRAM PERCY MAXIM, *President of the American Radio Relay League.*
E. F. W. ALEXANDERSON, *Chief Consulting Engineer of the Radio Corporation of America.*
MAJOR GENERAL CHARLES McK. SALTZMAN, *Chief Signal Officer of the Army.*
REAR ADMIRAL W. A. MOFFETT, *Chief of the Bureau of Aeronautics, U. S. Navy.*
DR. JOHN H. FINLEY, *publicist and journalist.*
Secretary: Dr. E. E. Free, 627 West 43rd Street, New York.

Advisory Committee

SENATOR JAMES W. WADSWORTH, JR., *of New York.*
HON. JOHN BARTON PAYNE, *Chairman, American Red Cross.*
ADOLPH LEWISOHN, *publicist.*
JUDGE BEN S. LINDSAY, *of the Juvenile and Family Court, Denver, Col.*
DR. J. MCKEEN CATTELL, *Past President, American Association for the Advancement of Science.*
DR. J. H. DELLINGER, *Past President, Institute of Radio Engineers.*
FARLEY OSGOOD, *Past President, American Institute of Electrical Engineers.*
C. E. GRUNSKY, *Past President, American Society of Civil Engineers.*
DR. DAYTON C. MILLER, *President, The American Physical Society.*
W. L. ABBOTT, *President, The American Society of Mechanical Engineers.*
W. J. HOLLAND, *President, Carnegie Hero Fund Commission.*
GEORGE K. BURGESS, *Director, Bureau of Standards.*
COLIN H. LIVINGSTONE, *Past President, Boy Scouts of America.*
DANIEL C. BEARD, *Chairman, National Court of Honor, Boy Scouts of America.*
MISS SARAH LOUISE ARNOLD, *President, Girl Scouts.*
DR. W. D. HAGGARD, *President, American Medical Association.*
K. A. BICKEL, *President, United Press Association.*
KENT COOPER, *General Manager, The Associated Press.*
H. P. DAVIS, *Vice-President, Westinghouse Electric & Manufacturing Company.*
DR. VERNON KELLOGG, *General Secretary, National Research Council.*
JESSE LYNCH WILLIAMS, *Past President, Authors' League of America.*
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WM. HAWLEY ATWELL, *Grand Exalted Ruler, Order of Elks.*
PROFESSOR EDWIN B. WILSON, *Harvard University, National Academy of Science.*
W. E. HARKNESS, *Vice-President, American Telephone & Telegraph Company.*
WILLIAM L. SAUNDERS, *President, United Engineering Societies.*
COL. J. R. MCQUIGG, *Past Commander, The American Legion.*
JOHN R. MOSS, *President, Kiwanis International.*
W. D. TERRELL, *Chief Supervisor of Radio, Department of Commerce.*

"Greatest Receiver Ever Developed"

In the latest issue of the *Citizens Radio Call Book*, there is a descriptive article regarding the *New Camfield Super-Selective Nine* Receiver. This circuit is considered by experts as the greatest receiver ever developed. An outstanding achievement is the simultaneous increasing of both selectivity and sensitivity to a point heretofore considered impossible.

CAMFIELD'S
Super-Selective Nine

The *Super-Selective Nine* offers to set builders unusual opportunities, for here is a circuit that will meet every requirement for the very best in radio reception. Another feature that will appeal to the radio public is the turning of a switch on the panel, which converts this set from a 5-tube, two-control receiver for local stations, to a nine-tube super-selective and super-sensitive circuit, capable of tuning through powerful local stations and receiving distant ones on a ten Kilocycle separation of frequency.

Write today for book on this wonder circuit and have the facts before you. Use the handy coupon below. Send 25c. today—now.

25¢

Camfield Radio Mfg. Co.
357-364 E. Ohio Street, Chicago, Ill.

mail Coupon now

Camfield Radio Mfg. Co.
357-364 E. Ohio St., Chicago, Ill.
Enclosed find 25 cents for booklet, "Camfield's Super-Selective 9."
Name.....
Address.....

Send for Latest RADIO CATALOG and GUIDE

Free 1927 Radio Guide

The big 164-page Barawik Guide book is used by hundreds of thousands of radio enthusiasts. It's the handiest and most reliable radio reference guide, and a big money-saver. Keep up to date by utilizing Barawik service.

164 Pages of Bargains

It gives 164 pages replete with reliable information about the newest and most advanced ideas in radio development, describes and illustrates the latest improvements. It will keep you posted on what's up to date. It will help you to build a better set, improve your old one and make it up to date or buy a complete new modern one. Every radio set owner, amateur, beginner and fan should have a copy.

Lowest Prices on Parts

It will pay you to get our prices for complete parts for the popular circuits featured in POPULAR RADIO and other magazines. Whenever a new circuit appears for which you want complete parts, write or wire us and they'll be on their way to you quickly. We know what parts to send you. Simply give name of circuit and we'll take care of the rest. We guarantee you a big saving on every order.

Send for Free Copy Now!

Get our new radio catalog today before you spend another cent on radio. Just mail the coupon and free copy will be sent you. Also please include name of a friend interested in radio.

BARAWIK CO.

Dept. 64
Chicago, U. S. A.

Mail This Coupon Now! For Free Copy

Name.....
Address.....
City.....
Fan.....
Address.....

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BROADCASTS

CONDUCTED BY CHARLES L. REESE, JR.

Re-broadcasting U. S. Programs

AMERICAN broadcast programs will be picked up and re-broadcast in England —if the plans of British radio engineers are carried out. Every Tuesday British broadcasting engineers will test the reception from the United States and whenever it is sufficiently good they will inform the London Station 2LO. The London program will then be switched off and an American program will be relayed to all listeners, even to those who own only crystal sets.

* *

The First Suicide for Love of a Broadcast Artist

WHAT is probably the first case of suicide due to unrequited love for a broadcast artist occurred in Vienna on February 6, when a fifty-two-year-old radio fan, a cook, turned on the gas in her room because of her failure either to see or to receive letters from an ethereal musician whose broadcast music had enthralled her.

* *

Radio Is Now a Billion-Dollar Industry

THE manufacture of radio parts has developed into a billion-dollar industry within six years, sales for the period from 1920 to 1926 totaling $1,492,000,000, Frank A. Arnold of the National Broadcasting Company, recently stated.

Annual sales mounted from $2,000,000 in 1920 to $500,000,000 in 1926, Mr. Arnold said, and so far only 6,000,000 of the 27,000,000 homes in the United States have been supplied with radio receiving sets. Of the 950 broadcasting stations in the world 678 are operated within the United States.

As indicating the immensity of the industry, Mr. Arnold declared there was a potential audience of 30,000,000 in the United States within reach of a single human voice. Directly and indirectly the industry gives employment to 300,000 persons, working for 3,500 manufacturers, jobbers and distributors. Last year $20,000,000 was spent on advertising by radio in this country through 400 stations accepting paid advertising, and twelve New York City newspapers carried 3,500,000 lines of radio advertising.

* *

A Novel Invitation to Tune In

HERE is a novel form of announcement of a broadcast program feature; it came to the editor of POPULAR RADIO in the shape of a *fac-simile* reproduction of a long-hand note:

> Mrs. Clayton Darius Lee requests the honor of your company at the radio, Fridays in February at two-forty, and asks you to "Tune In," on *"WJZ"*
> R. S. V. P. (after the talks)
> Mrs. C. D. Lee,
> 790 Broad Street,
> Newark, New Jersey.

* *

A Radio-Equipped Expedition to Persia

WHEN the Forbes-Leith Expedition to Persia penetrates the wilds of the country, it will depend upon radio for maintaining its contact with civilization. The fortunate young radio amateur selected for this important task is a friend of the POPULAR RADIO family—Charles E. Warren, Jr., of New York. He reports that the portable transmitter selected is built to operate on 20, 34, and 44 meters; the power rating is normally 250 watts. A UV-204-a tube is used with a DC plate supply of 2000 volts. The circuit is the Hartley. A Grebe receiver, type Cr. 13, will be carried. The expedition is already on its way.

* *

A "Vest Pocket" Set

AN approach to the long-heralded "vest-pocket radio receiver" is made in the minature portable set recently patented by Henry Csanyi of New York. His invention (Patent No. 1,617,236) is described as "a unitary and hand-portable radio receiving set, comprising a telephone receiver with its coil and diaphragm, a tuning coil disposed adjacent the receiver coil, a fixed crystal detector, including a crystal and a detector contact cooperating therewith and arranged at the axis of the tuning coil."

Changes in the List of Broadcasting Stations in the U. S.

During the month of February, 1927, the following changes were reported in the list of broadcasting stations:

STATIONS ADDED

WMBL	Lakeland, Florida	418.0
WFLA	Boca Raton, Florida	448.0
KFGQ	Boone, Iowa	360.0
KGEX	Muscatine, Iowa	258.0
KGEZ	Kalispell, Montana	252.0
KGFF	Alva, Oklahoma	286.4
WMBO	Auburn, New York	238.0
WMBN	Memphis, Tennessee	246.0
WEBE	Cambridge, Ohio	234.0
WJPW	Ashtabula, Ohio	238.0
KROX	Seattle, Washington	286.3
WLBM	Boston, Massachusetts	468.8
KGEO	Grand Island, Nebraska	271.8
KGFG	Oklahoma City, Oklahoma	384.4
WMBQ	Brooklyn, New York	218.0
WMBU	Pittsburgh, Pennsylvania	238.1
KSCJ	Sioux City, Iowa	444.8
WMBR	Tampa, Florida	238.0
WMBW	Youngstown, Ohio	278.0
KGFH	La Crescenta, California	218.8
WMBX	Columbus, Mississippi	286.3
KGFI	Fort Stockton, Texas	238.4
WNBF	Endicott, New York	286.4
KOLO	Durango, Colorado	366.1
WMBY	Bloomington, Illinois	291.1
KGFJ	Los Angeles, California	218.0
KGA	Spokane, Washington	348.7
WNBA	Forest Park, Illinois	238.0
WFIW	Hopkinsville, Kentucky	368.9
WNBK	LeRoy, New York	354.0
KGFM	Yuba City, California	468.8
KGFK	Hallock, Minnesota	226.0
WNBJ	Knoxville, Tennessee	236.0
WNBI	Peru, Illinois	267.0
KWBS	Portland, Oregon	268.0
WNBL	Bloomington, Illinois	486.0
KLIT	Portland, Oregon	238.0
KGFL	Trinidad, Colorado	222.0
WALK	Bethayres, Pennsylvania	286.8
KELW	Burbank, California	535.0

STATIONS DELETED

WLBU	Canastota, New York
WGBR	Marshfield, Wisconsin
KXRO	Seattle, Washington
KGDI	Seattle, Washington
KFYO	Texarkana, Texas
WWPR	Detroit, Michigan
KFOO	Salt Lake City, Utah

CHANGES IN CALL LETTERS

WLBA	Philadelphia, Pa.	*change to*	WPSW
WMBX	Columbus, Miss.	*change to*	WCOC
WGHB	Clearwater, Fla.	*change to*	WFHH
WSWS	Batavia, Ill.	*change to*	WTAS
KFQP	Iowa City, Iowa	*change to*	KGFB
KGDZ	Decorah, Iowa	*change to*	KWLC
KOMO*	Seattle, Wash.	*change to*	KGFA

CHANGES IN WAVELENGTHS

WCSH	Portland, Me., 256.3	*change to*	468.7
WOK	Homewood, Ill., 217.3	*change to*	418.0
KGCN	Concordia, Kan., 210	*change to*	226.0
WMPC	Lapeer, Mich., 222	*change to*	282.0
WFHH	Clearwater, Fla., 265.3	*change to*	366.4
KDYL	Salt Lake City, Utah, 245.8	*change to*	246.8
KGCG	Newark, Ark., 239.9	*change to*	224.2
WBBC	Brooklyn, N. Y., 249.9	*change to*	267.7
WKBO	Jersey City, N. J., 220.4	*change to*	472.2
WGBU	Fulford, Fla., 277.6	*change to*	394.4
WCRW	Chicago, Ill., 416.4	*change to*	416.7

* These call letters have been assigned to another Seattle station.

* *

Federal Radio Commission Nominated

JUST as this issue of POPULAR RADIO goes to press, President Coolidge sent to the Senate the nominations of the five members of the Federal Radio Commission provided for by the new law. The nominees were as follows:

William H. G. Bullard, Rear Admiral, U. S. N., retired, of Media, Pa.; for a term of six years.

Orestes H. Caldwell of Bronxville, N. Y., editor of *Radio Retailing;* five years.

Eugene O. Sykes of Jackson, Miss., former Justice of the Supreme Court of Mississippi; for four years.

Henry A. Bellows of Minneapolis, director of Washburn-Crosby radio station; for three years.

John F. Dillon of San Francisco, supervising radio operator; for a term of two years.

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Trans-Oceanic Calls Heard

POPULAR RADIO has now completed arrangements for forwarding to transmitting amateurs in England, France, Germany, Austria, Ireland and Italy all calls heard (QSL) cards that may be addressed to them by American amateurs care of this magazine. These cards will be delivered through local agents in those countries, who have or can obtain knowledge of the present address of the foreign amateurs. Plans have also been completed by this magazine for forwarding to transmitting amateurs in this country in turn all QSL cards that may be addressed to them by amateurs from those countries. American amateurs are invited to send their cards to foreign amateurs through this office, which will not only assure safe delivery through the special agencies which are thus provided, but which will publish a monthly list in a "Trans-Oceanic Calls Heard" department.

Address your cards to the foreign amateurs by call numbers and enclose them in envelopes to—

The Calls Heard Editor,
POPULAR RADIO
627 West 43d Street, New York

THE following stations were received and logged at the amateur station of W. M. Smith (U-3GP) at 1729 Irving Street, Washington, D. C., on a special type of receiver employing two stages of audio:

F-8BRN—Jan. 24, 1927; signal strength R3; calling CQ;
F-8JRK—Jan. 24, 1927; signal strength R4; calling CQ;
P-1AE—Jan. 25, 1927; signal strength R5;
B-8O—Feb. 1, 1927; signal strength R5; heard calling CQ and, later, working U-8EU;
Y-2YT—Jan. 30, 1927; signal strength R6; calling CQ;
EF-8OLO—Jan. 5, 1927; signal strength R5; calling CQ;
EF-8YOR—Jan. 5, 1927; signal strength R4; calling CQ and later working NU-5BY;
EB-Z1—Feb. 7, 1927; signal strength R5; calling CQ;
EK-4UAH—Jan. 4, 1927; signal strength R5.

THE following stations were received and logged at the amateur station of S. Williamson (G-2ACI) at 22, Hurst Grove, Bedford, England, on an 0-v-1 Reinartz receiver:

U-3CMZ—Aug. 17, 1926; signal strength R4; calling CQ on 38 meters; AC note; atmospherics R2;
U-9BPB—Aug. 18, 1926; signal strength R4; calling U-2BS on 38 meters; AC note; no fading;
U-3LD—Aug. 18, 1926; signal strength R4 to R5; calling CQ on 38.25 meters; DC note; noticeable atmospherics; slow fading;
U-4LK—Aug. 18, 1926; signal strength R3; AC note on 38.7 meters; atmospherics R6;
U-3CJN—Aug. 17, 1926; signal strength R2; calling CQ on 40 meters; DC note; no fading;
U-4RR—Aug. 11, 1926; signal strength R3; calling CQ on 38 meters; DC note; no fading.

THE following stations were received and logged at the receiving station of J. Thomas (R-274) at 3 Avenue des Chalets, Paris (XVIme), France, on an 0-v-1 Reinartz receiver with a single-wire antenna 8 meters long and no ground:

U-9BLF—Sept. 28, 1926; signal strength R5 to R6; good, steady wave; much interference from American stations;
U-9CET—Sept. 30, 1926; signal strength R6 to R7; good, steady, rectified AC note; much interference from American stations;
U-5LE—Sept. 28, 1926; signal strength R3; rectified AC note; interference from U. S.;
U-5MAJ—Oct. 2, 1926; signal strength R3 to R4; DC note; much interference from U S. station;
U-3AFW—Oct. 2, 1926; signal strength R7; good, steady, rectified AC note; much interference from U. S.;
U-4AAH—Oct. 2, 1926; signal strength R6; DC note; much interference from U. S.;
U-9BEQ—Sept. 30, 1926; signal strength R3; DC note; much U. S. interference;
U-7EK—Sept. 30, 1926; signal strength R5 to R6; rectified AC note; very bad fading; much interference from U. S. stations;
U-7WU—Sept. 30, 1926; signal strength R5; rectified AC note, almost DC; bad fading; much U. S. interference.

* * *

Do You Know That—

AT the first of the year there were 668 licensed broadcasting stations in the United States, operating on the 89 available wave bands?

Since November, 1920, 1,538 broadcasting stations have been licensed by the United States Government; of this number over 60 percent have been discontinued.

No one broadcasting station can, at the present time, render regular dependable, day and night service all the year round to an audience more than 100 miles from its antenna.

There is an average of five listeners to each radio receiver, according to a recent estimate made by radio engineers.

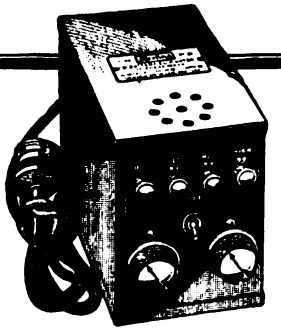
A recent questionnaire sent to broadcast listeners indicated that 51 percent of set owners also owned their own homes, 46 percent owned their own pleasure cars; 50 percent owned pianos and 74 percent owned phonographs.

Estimates of the radio audience in the United States range from 16,000,000 to 25,000,000 people.

There are more receiving sets owned and operated in the United States in January, 1927, than there were a year ago; a recent survey shows that a year ago there were eight cities which have over 200,000 receivers, as follows:

New York	628,000
Boston	345,000
Chicago	354,000
Detroit	266,000
Philadelphia	247,000
Cincinnati	216,000
Pittsburgh	214,000
Cleveland	206,000

New
Sterling
Raytheon Tube
"B" Eliminator
for **$28.00**



Model RT-81

THIS low-priced "B" Eliminator is ideal for all five-tube sets including Radiolas 25 and 28.

It embodies the Sterling perfected adjustment for high, intermediate and detector voltages. It adds tone quality to your reception.

No larger than a single dry "B" Battery, it delivers three times the voltage.

And it gives sure, silent, steady power. Easily installed too. Complete with long-lived B. H. Raytheon Tube—$28.00.

Sterling
"B" ELIMINATORS

Ask your Dealer for Sterling RT-81 or send for complete description.

THE STERLING MFG. CO.
2831 Prospect Ave. Cleveland, O.

Raytheon

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Before Deciding Where to Buy Your Kit

CONSIDER

THAT, the Precision Coil Company has specialized in Popular Radio kits for the past three years.

THAT, we have sold thousands of kits to satisfied fans all over the world.

THAT, all parts are exactly as used in the Popular Radio Laboratory model.

THAT, we guarantee all kits fully for workmanship and materials.

ORDER YOUR KIT FROM THE PRECISION COIL CO., AND BE SURE OF SATISFACTION

KITS IN STOCK

Univalve Receiver, complete with tube.....$47.45
Sir Oliver Lodge N Circuit, complete with tubes.....$49.25
The K. H.-27.....$86.00
The LC-27.....$85.20
LC Senior Power Pack.....$65.00

And others.

Write us today enclosing check or money order. Kits built complete for small additional fee, if desired

PRECISION COIL CO., Inc.
209 CENTRE ST., NEW YORK CITY

YOUR OWN BUSINESS Without Capital

Right now, there is an opportunity in your locality to profitably devote your spare time or all your time to a pleasant, easy and profitable business—one that does not require any training or capital.

The publishers of POPULAR RADIO offer you an opportunity to become their local representative to take care of expiring subscriptions and new subscriptions for POPULAR RADIO and one other popular magazine that they publish.

SALARY AND COMMISSION

All material will be furnished you free of charge and you will be paid an attractive commission and salary.

Mail coupon for full particulars.

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627 W. 43rd St., New York City.

Send me full particulars regarding your salary and commission offer to local representatives.

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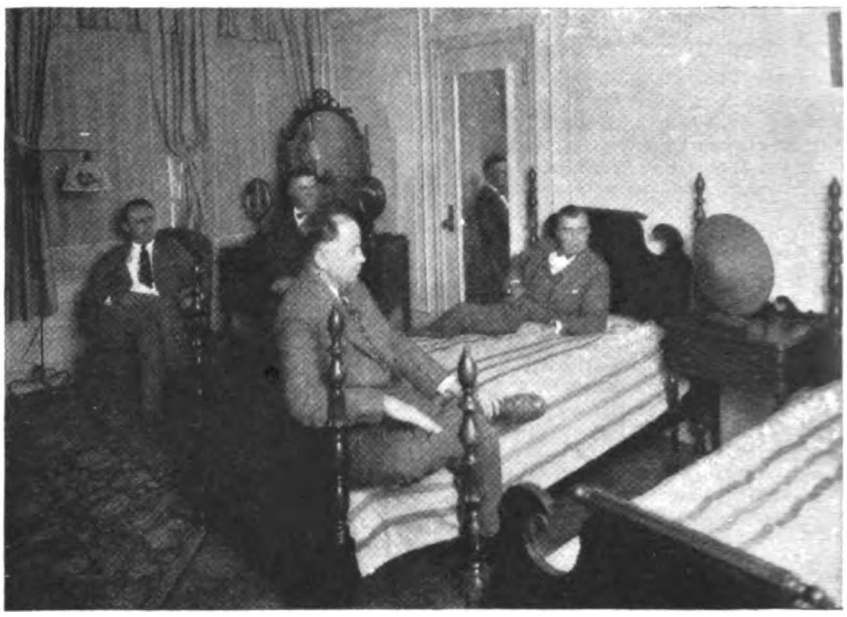

R. G. Moffett

A LOUDSPEAKER IN EVERY ROOM

By merely applying at the office, every guest of the George Washington Hotel of Jacksonville, Florida, may obtain a loudspeaker to plug into the socket provided for that purpose in his room. A Western Electric 4-B superheterodyne receiver is employed for reception. The installation cost $10,000.

BROADCAST LISTENER

Comments on radio programs, methods and technique —from the point of view of the average fan

By RAYMOND FRANCIS YATES

Is the Microphone Showing Up the Opera Stars?

IF the radio does one thing, it puts in their proper places the vocal stars and near stars who, largely through the scheming and alacrity of a publicity man, have buncombed this land into believing that they are artists of the first water and that their warbling has that charm that comes only from the throat of the genius. Put Mary Smith and Sadie Jones on the air with Marion Talley or Frances Alda and you will convince yourself that access to stardom is either a matter of publicity, spondulics or influence with the powers that are able to make big singers out of little ones.

During our experience with the radio we have heard literally hundreds of young sopranos who (provided they are fairly presentable) could match any of Talley's performances so far as radio performances are concerned, and who could, given a beautiful gown, a concert hall and a manager in a frock coat, put on a show that would draw admissions from the snootiest critics. After all is said and done, all a concert singer needs is a voice that will get by with a solo in any Fifth Avenue church and a concert hall affording the proper environment. Any good publicity man, furnished with enough money, can perform the miracles that make first-class stars from this kind of material.

Take the glittering concert hall and the sparkling gowns away from the majority of our metropolitan stars and place them beside a young lady with something a trifle better than the voice of the average radio soprano and you will, unless you are familiar with the idiosyncrasies of each voice, be unable to distinguish one from the other. During a recent recital over the radio by Frances Alda, this very thing was proven; Alda, to our way of thinking, took her position among thousands of musical nobodies who had appeared before the very same microphone. Even her repertoire was chosen a bit amateurishly, and, all in all, she gave a demonstration that was forty kilometers from justifying her position in the world of music. And there are others.

* *

The Nuisance of the Religious Propagandists

ALL of our half-baked and shoddy theologians, it would seem to one who watches the radio closely, are unloading much loose-talk into the microphones of the country nowadays. If they do not have access to a broadcaster supported by their own cult for propaganda purposes, they sally forth to convince the proprietor of otherwise respectable studios that, aside from the house of God, itself, the radio is the greatest soul-saving device ever created

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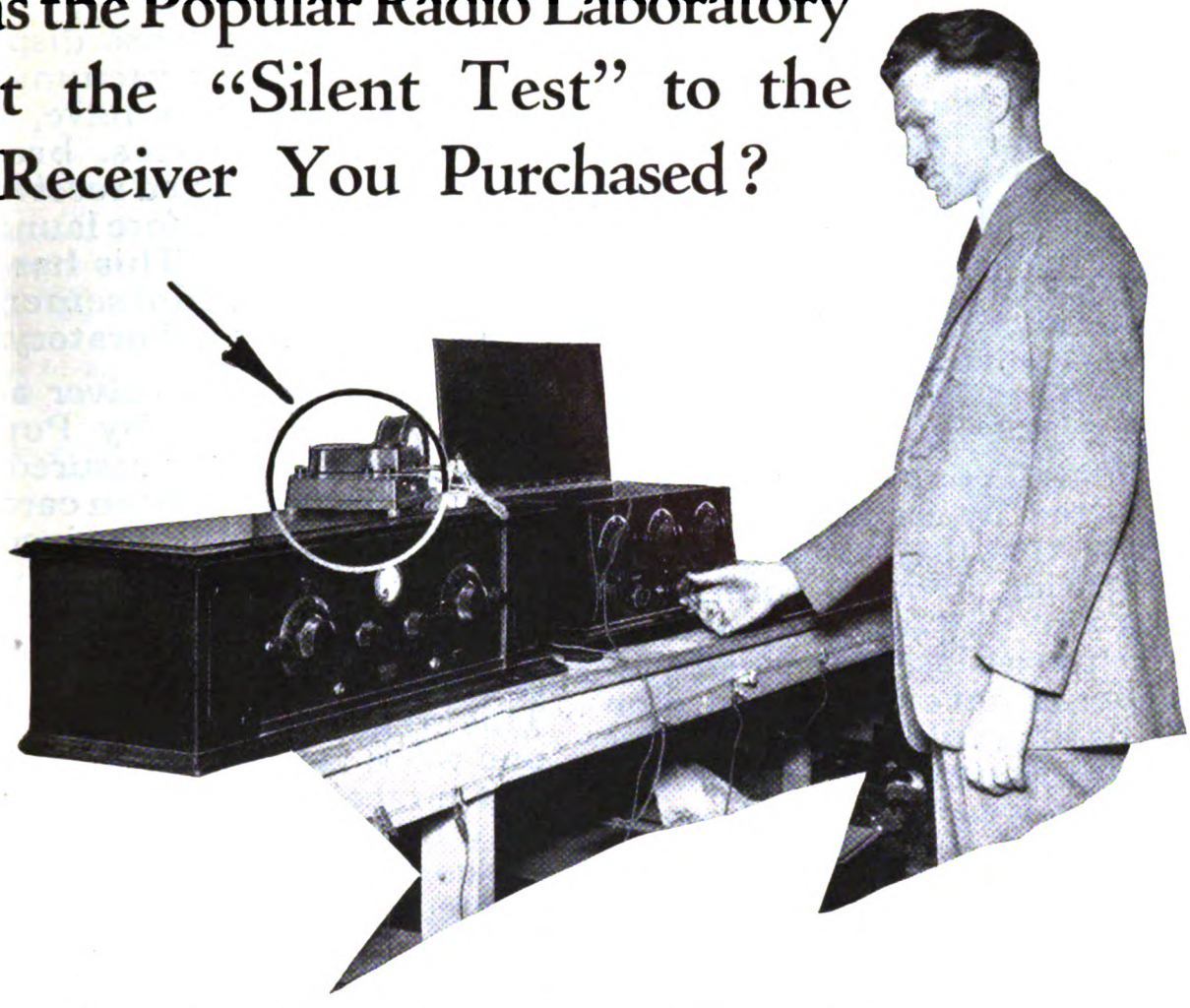
Has the Popular Radio Laboratory Put the "Silent Test" to the Receiver You Purchased?



You May Buy With Confidence When the Popular Radio Laboratory Says: "APPROVED"

BUYING a radio receiver solely on the strength of its appeal to your ear is like purchasing a clock simply because you like its tick. It may be a badly designed clock with a weak spring, a fluctuating escapement and it may be an inaccurate keeper of time. The same applies to your radio receiver. It may sound well; it may look well, but, like Pandora's chest, it may be filled with hundreds of little imps of bad engineering who will murder your "B" batteries, interfere with your selectivity, poison your vacuum tubes and finally exhaust your temper and your pocket-book. It is not difficult to find a radio that will please your ear and match your purse, but that is only two

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of many things you must insist upon — that you must know — to make your purchase safe. How would the set of your choice perform on Popular Radio's "Silent Test"?; how would it answer the doubts of Popular Radio's engineering department when they forced it to "speak" through the medium of milliammeters, millivoltmeters, audibility meters and thermo-couples instead of a loudspeaker? Perhaps it would tell a shocking story of the many engineering crimes committed by its designers. It might be that this "third degree" would bring about a confession telling why you used four sets of "B" batteries last year when two sets should have been plenty or perhaps, it would throw light on the mysterious way in which the rectifier valves in your "B" eliminator "burn out."

How can you buy with confidence? Certainly not merely by listening. You can't hear losses in a high-frequency coil nor can you see the grid bias on the power tube. These things *must be measured* and many of them should be known before you purchase a receiver. But you probably could not do these things yourself even if you owned the proper oscillators and measuring instruments. The dealer would not permit you to turn his shop into a testing laboratory.

So confident has the radio trade become in the severity, honesty and engineering sense displayed in the laboratory vacuum tests that manufacturers have, in innumerable instances, brought their newly designed receivers in for examination before launching into production. This has been a gratifying indorsement of Popular Radio's Laboratory.

In purchasing a receiver advertised in or tested by Popular Radio, you can rest assured that its performance has been carefully checked up by the engineers of the Popular Radio Electrical Testing Laboratory and that a thorough record of its technical pedigree has been put on file. This great amount of work (about one week is required to properly test a receiver) is done that you may buy with confidence; with the comfortable feeling that your interests have been protected.

As you probably know, Popular Radio does not accept receiver advertising at random. It is guided by the readings of sensitive meters and by its own conscience. Remember that the popularity of a receiver is not always an index to engineering perfection, but a set advertised in Popular Radio may always be taken to mean that it represents, what is considered to be the best engineering practice of the day at the price offered.

The laboratory has spared no one in its tests and there is on the market today receiving sets that could not, under any circumstances, be advertised in the pages of the magazine. A publication must keep the faith of its readers regardless of costs.

A list of tested and approved receivers may be had by addressing a stamped and self-addressed envelope to the Service Department, Popular Radio, 627 West 43d Street, New York City.

POPULAR RADIO Laboratory
"Buy-With-Confidence" Series No. 1.

POPULAR RADIO, Inc.

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and that their message—always charged with the divine stuff, of course—will give a studio prestige among the Christian brotherhood.

Few broadcasters, if any, apparently have the courage to refuse these agents of the Kingdom; and daily the air is made heavy with their vapid rantings.

On Sunday the radio sets of the land become mere instruments for salvation; and, regardless of the geographical location of one's domicile, there is practically nothing to listen to but the lessons of the fathers. Whether it is fear or faith that causes our studio managers to place their facilities at the disposal of the churchly brethren is not a question to be answered by this Department, but the fact remains that on Sunday radio is solely in the hands of God's self-appointed engineering staff. The listener is a target for the howlers of cults bearing all shades of theological coloring, from the clowning Billy Sunday's to the highly dignified and reverend gentlemen who are entrusted with the souls of the more successful Babbitry.

During a holiday visit to Buffalo where the magic bunk of the doctors of evangelism is practiced as assiduously as any place in the United States, we had occasion to observe the dedication of still another microphone to holy purposes and to collection plates heavy with the hard-earned lucre of the yokels. This radio tabernacle with its clowning disciple is but one of an already large and still growing number of such institutions. It renders futile the efforts of many Buffalo broadcasters who attempt to use the air while the ballyhooing brethren are throwing out their challenges to the heathen. The owners of this new ether bunk mill are as insolent as they are inconsiderate; they well represent that brazen clique of mountebanks who see in the radio a device to keep the evangelical industry in a thriving condition.

* *

The Position of the "Radio Critics"

THIS commentary is becoming increasingly difficult to prepare; we have arrived at a point in our critical career where we find few things to shoot at that have not, at some previous date, been shot at before. For over five years now, we have been wadding up these critical pellets to heave at the studio managers, and we have, we now feel, become practically exhausted of any ideas that are worth exposing to the intense minds of our readers. We have squirted ink at the announcers; we have accused the studio managers of incompetency; we have waged, in our own crude way, unmitigated warfare against the soprano epidemic; we have aimed many a ripe tomato at the parlor baritones, and, God knows, our supply of bad eggs has been spent upon the windjammers who daily and nightly caress our microphone with sweet nothingness. And of what avail has all of this shouting been?

Radio is still pretty much in its overalls; it still awaits those tempering touches that will make of it something akin to an art rather than a raw entertainment with no more pattern and certainly with no more contemplation than is exercised by a child using building blocks.

If radio has failed to do one thing, it has failed to take fullest advantage of the criticism it has received from the press. Our studio managers, it seems, have come to look upon radio critics as egotistic blackguards, fully unaware of the problems that beset the makers of programs, and are motivated by nothing more lofty or inspiring than the desire to gush steam and vitriol. The radio critic, to hear the novitiates of the studios, is a mere nuisance who airs nothing but private opinions for no reason at all, and who has not the slightest knowledge of the deeper problems of the art. This viewpoint of the studio managers is, unfortunately, true in many cases, due, it would appear, to the poor choice of talent made by the editors of the country. On the other hand, a surprisingly large number of the better papers have engaged sober, sincere and capable men for this work. But whether it is confusion or pure incompetence, our studio impresarios regard all critics who attempt to write something more sincere and pointed than dishwater, as meddlesome imbeciles trying to display something they do not have.

At least twenty-five percent of the radio criticism printed has been sound and honest; but our studio managers go on stubbornly making the errors and overlooking the opportunities for improvement that are so clearly pointed out. They cannot read anything more important into this criticism than so much *blah-blah*.

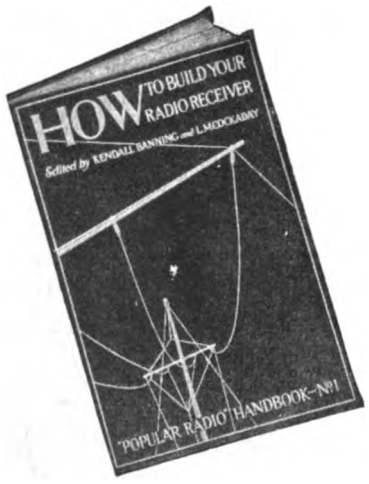
It is evident that our impresarios of the radio must learn to be less dogmatic and more tolerant of the radio critic who is really trying to point out some of the obvious weaknesses of broadcasting.

* *

Hello, Roxy!

Now that Roxy has returned to the air with the original members of the old gang and a 110-piece symphony orchestra to boot, the best efforts of many of our great studio directors bid fair to be very badly outdone. Roxy's standards are not only high but his showmanship has always worried his competitors, whether in the theater or on the air. The radio fans appear to be in for an enlivening period of broadcast entertainment.

FREE



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POPULAR RADIO

Aside from the feature of economy, there is the thrill and satisfaction that comes from building your own receiving set.

Thousands of sets have never been constructed because of the atmosphere of mystery that has enveloped the whole subject of radio. Kendall Banning, Editor, and Laurence M. Cockaday, Technical Editor of POPULAR RADIO, through their close contact with the great radio public, sensed this and compiled a book that will convince the veriest beginner that technical training is not essential. If you have a little time to devote to a most fascinating pastime, send for a copy of "How to Build Your Radio Receiver."

Free Advisory Service

POPULAR RADIO is full of helpful suggestions as well as instructive and entertaining articles on radio and allied scientific phenomena. This information is supplemented by an advisory service that is free to all subscribers. Any problem you encounter that is not answered in the book or magazine will be answered by personal letter if you will submit it to the Technical Service Bureau.

A Valuable Combination

For the next thirty days we will give you a copy of "How to Build Your Radio Receiver," FREE and enroll you for all privileges of the Technical Service Bureau at no further expense, on receipt of your remittance of $3.00 in payment for a 12 months' subscription for POPULAR RADIO. (As an alternative offer, if you wish the combination with POPULAR RADIO for 7 months only—send but $2.00). In any event, you run absolutely no risk, as we will refund in full if you are not more than satisfied with your purchase.

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In "How to Build Your Radio Receiver" you will find complete constructional diagrams, specifications, photographs and instructions for building the following sets. Each has been selected as representative of its circuit because in laboratory tests it proved the best for distance, selectivity, tone volume, simplicity of construction, ease in tuning, reliability and all-around satisfaction.

A $5 CRYSTAL SET
THE HAYNES SINGLE TUBE RECEIVER
A TWO-STAGE AUDIO-FREQUENCY AMPLIFIER
THE COCKADAY 4-CIRCUIT TUNER
A 5-TUBE TUNED RADIO-FREQUENCY RECEIVER
THE "IMPROVED" COCKADAY 4-CIRCUIT TUNER
THE REGENERATIVE SUPER-HETERODYNE RECEIVER

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Offer expires April 30th, 1927

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Enclosed remittance of $3.00 is payment in full for a 12 months' subscription for POPULAR RADIO and copy of "How to Build Your Radio Receiver" FREE.

Name.....

Address.....

City.....State.....

☐ Check here and remit $2.00 if you prefer POPULAR RADIO for 7 months only in combination with "How to Build Your Radio Receiver."

Through this man's invention the Musicone revolutionizes the loud speaker field ... ...

Powel Crosley Jr

C. A. Peterson, only 24 years old, is responsible for the amazing tone, the surprising volume and the startling fidelity of reproduction of the Crosley Musicone.

Nearly three years ago a shy and reticent young man walked into the office of Powel Crosley, Jr., with an idea for a radio loud speaker under his arm. When he unwrapped the newspaper around it, Mr. Crosley instantly saw its great possibilities.

Mr. Crosley offered him the equipment of his laboratories, the assistance of his engineers and the resources of his company.

In a short time Peterson produced a marvelous actuating mechanism so designed as to vibrate freely without choking regardless of the heavy electrical impulses applied to it. It revolutionized the loud speaker field.

Within a few weeks after its announcement the Musicone captured the loud speaker market and has dominated it ever since. Horns with their ugly appearance and their harshness of reproduction which so discredited radio in early days were promptly obsoleted.

The Musicone has been imitated in appearance but the patented actuating unit has never been equalled. Incidentally, Mr. Peterson's royalties on this instrument have been over $90,000.

Attached to a good radio the Musicone delivers pure, true tones, without distortion regardless of how suddenly the crashes of orchestra or high shrill notes come through it.

As an ornament its rich bronze frame and the quiet tones of its ornamental cone are an addition to the decorations of any room. Made in two sizes and at two prices without any difference in quality.

The 12-inch Ultra Musicone for small rooms, apartments, etc. ..... $ 9.75

The 16-inch size Super Musicone for large rooms or porch use $14.75

NOW! The Genuine CROSLEY MUSICONE $9.75 16 inch size .. $14.75

Prices slightly higher west of the Rocky Mountains

Crosley Radios $29. to $98.

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Powel Crosley, Jr., Pres.

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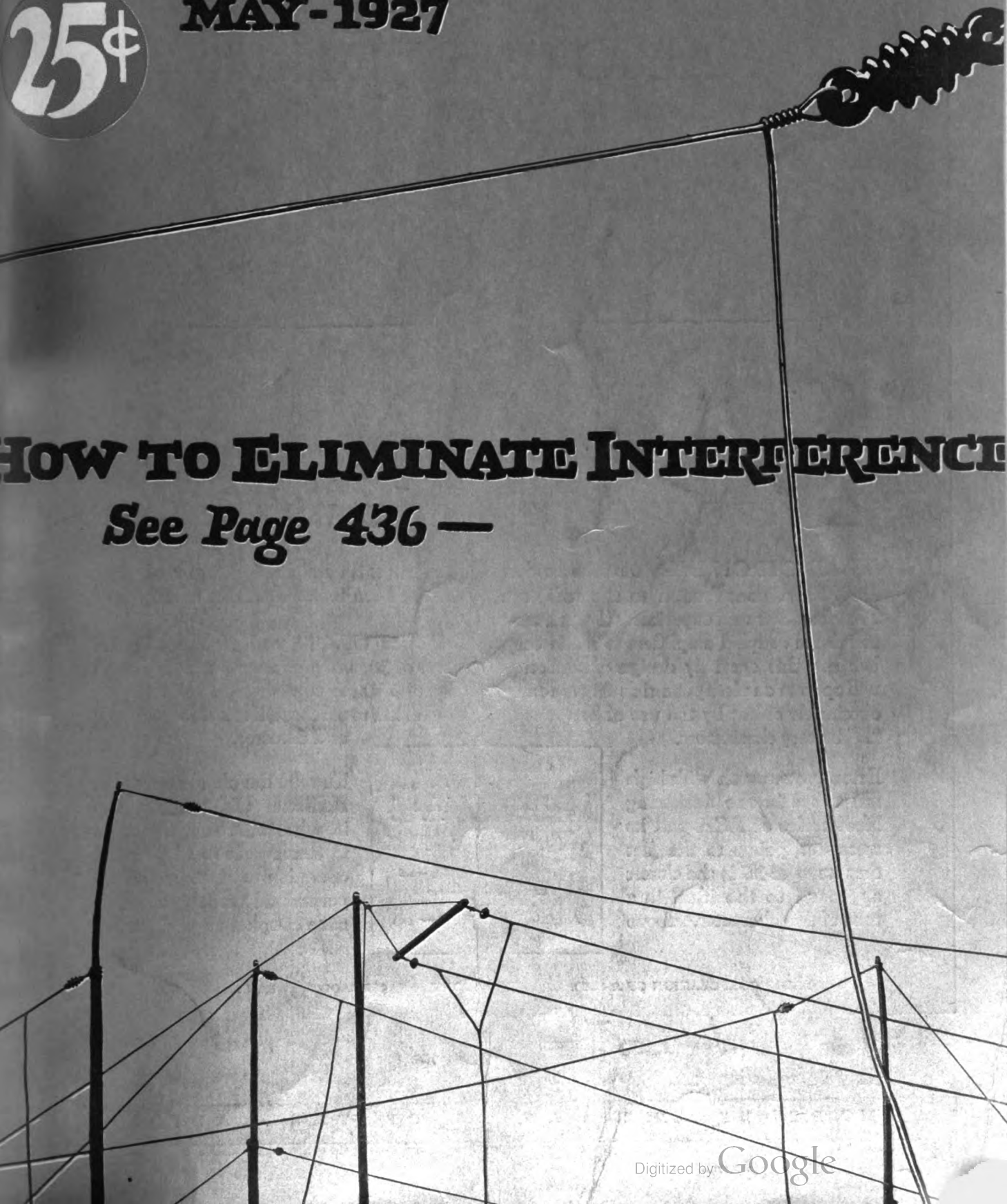
MAY-1927



How to Eliminate Interference

See Page 436 —

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RCA ANNOUNCES
RADIOTRON UX-240

for resistance coupled amplification

RADIOTRON UX-240 marks another RCA contribution to the radio art. Now amateur and experimental work with resistance coupled amplifiers is made easy, because this specially designed Radiotron will operate on plate potentials that are easily obtainable either by the use of batteries or "B" battery eliminators.

Extensive research with high mu tubes in the designing laboratories of RCA and its associates, points to the fact that a mu of 30 is the closest approach to the ideal in a tube of this character. Above or below this amplification factor of 30, it has not been found desirable to go.

Radiotron UX-240, with its amplification factor of 30, will give excellent results with only two stages of resistance coupling, instead of the usual three, if it is also employed as a detector.

To read the characteristics of Radiotron UX-240 is to realize what RCA has contributed in convenience and practical operation to amateur and experimental work with resistance coupled amplification.

CHARACTERISTICS

Filament Volts	5.00
Filament Amperes	.25
Plate Milliamperes (approx.)	.2
Amplification factor	30

"B" Voltage	Plate Coupling Resistance	Amplifier "C" Volts
180	250,000	−3
135	250,000	−1.5

Stopping Condenser .005 to .05 Mfd.

Amplifier Grid Leak 2 Megohms

Price $2.25

RADIO CORPORATION OF AMERICA NEW YORK CHICAGO SAN FRANCISCO

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA

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Eveready Layerbilt "B" Battery No. 486, the Heavy-Duty battery that should be specified for all loud-speaker sets. Price $5.00.

The Layerbilt patented construction revealed. Each layer is an electrical cell, making automatic contact with its neighbors.

Radio is better with *battery* power

RADIO receivers designed for quality reproduction operate best on well-made dry cell "B" batteries. What your ear tells you about the performance of battery-run sets is confirmed by laboratory tests that reveal that batteries alone provide steady, noiseless "B" current, taking nothing from and adding nothing to radio reception. Batteries, and batteries alone, provide pure DC (pure Direct Current). Only such current can give you the best results of which your set is capable.

Battery Power is dependable, convenient, and reliable, under your sole control, ever ready to serve you when you turn on your set. As your "B" batteries approach the end of their service, a slight drop in volume warns you in ample time. You need never miss a single concert if your set is battery-equipped.

Not only in results, convenience and reliability are "B" batteries unequaled, but they are also unapproached in economy, provided, of course, the correct size batteries are used. That means the Heavy-Duty type for all receivers operating loud speakers, as most do nowadays. Smaller batteries are not as economical, though they give you the quality advantages of Battery Power.

For maximum economy, choose the Eveready Layerbilt "B" Battery No. 486. In every test and trial this has proved conclusively to be the longest-lasting "B" battery ever built. Its unique and patented construction is responsible for its astonishingly long life. It is, we believe, the most economical, as well as the most satisfactory, convenient and reliable source of "B" current available. Just remember this: Radio is better with *Battery* Power, and the Eveready Layerbilt "B" Battery No. 486 offers you that power most economically.

NATIONAL CARBON CO., INC.
New York San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night —9 P. M., Eastern Standard Time

WEAF–*New York*	WGN–*Chicago*
WJAR–*Providence*	WOC–*Davenport*
WEEI–*Boston*	WCCO–*Minneapolis, St. Paul*
WTAG–*Worcester*	KSD–*St. Louis*
WFI–*Philadelphia*	WRC–*Washington*
WGR–*Buffalo*	WGY–*Schenectady*
WCAE–*Pittsburgh*	WHAS–*Louisville*
WSAI–*Cincinnati*	WSB–*Atlanta*
WTAM–*Cleveland*	WSM–*Nashville*
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Popular Radio

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FOUNDED 1911

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VOLUME XI | MAY, 1927 | NUMBER 5

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JOHN V. L. HOGAN, *Contributing Editor* | E. E. FREE, Ph.D., *Contributing Editor*

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BROWNING-DRAKE KIT

Antenna system—One Browning-Drake space wound antenna coil, mounted on .0005 condenser, with velvet vernier illuminated dial.

Regenaformer system—One Browning-Drake transformer; slot wound primary, space wound secondary, mounted on one .00025 condenser with velvet vernier illuminated dial. Complete with instructions. List price, $25.00.

B-D FOUNDATION UNIT

Consists of front and base panels, drilled and engraved; with sockets, resistor clips, soldering lugs, machine screws and wire. List price, $15.00.

NEUTRALIZER

The Browning-Drake balancing or neutralizing device lists for $1.00. This system of neutralization is recommended by Browning and Drake.

CARTRIDGE RESISTANCE

The cartridge resistance—another Browning-Drake Corporation product. Lists for 75c.

GET ~ DISTANCE

with the *new* Official BROWNING-DRAKE KIT SET

WHAT is believed to be a trans-continental reception record—Los Angeles from Boston—seven consecutive nights—was recently established by a standard factory-built Browning-Drake (confirmation on request). The extreme distance-getting ability of Browning-Drake is well known. The new Official Browning-Drake design for the home constructor, incorporating the Browning-Drake Corporation Kit and Foundation Unit, makes it possible to construct readily a set which will meet the wildest dreams of the DX hound.

Tone quality is almost perfect through the use of impedance and resistance audio amplification. This amplifier was designed for use with a "B" eliminator and power tube.

Complete constructional data is available in booklet form for twenty-five cents, either through your dealer or direct.

BROWNING-DRAKE CORPORATION
BRIGHTON MASS.

DEALERS: There should be at least one distributor in your territory handling complete receivers, as well as all the parts for the Official Kit Assembly. We will be glad to forward the name of our nearest jobber.

BROWNING-DRAKE RADIO

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A Page With The Editor

THE fact that President Coolidge, in selecting the personnel of the Radio Commission, picked out capable men who really know something about radio, and that he did not yield to the pressure of some of his political advisors to appoint "lame ducks," augurs well for the broadcast listener and consequently for the radio industry.

* *

DESPITE the failure of the late Congress, which authorized the creation of the Radio Commission, to provide an appropriation for it, the Commission has proceeded to business with a promptness that promises to dispel much of the confusion that has prevailed in the broadcasting field and to stabilize an industry that has been, for many months, in dire need of legalized leadership.

* *

ALTHOUGH the rulings of the Commission may be subject to question by the courts, the general impression prevails that its activities will be of substantial benefit to the industry, and that they will warrant manufacturers to proceed with their plans on a larger scale than ever before—to the great good of the radio fan and of the radio experimenter

* *

FOLLOWING up their article, "How to Build the New Standard Browning-Drake Receiver," in the April issue, Mr. Glenn H. Browning and Dr. Frederick H. Drake, the inventors of this famous circuit, will make another important contribution to the coming (June) number of POPULAR RADIO; it will give the full constructional details of an "ABC" power-pack for the complete operation of the Browning-Drake receiver without the use of batteries.

* *

To the fan who likes to carry a portable set about with him on his summer jaunts, the article by William F. Crosby, on page 431 of this issue, is of timely and practical interest. For this is the time of year to get that portable set ready!

* *

MR. CROSBY does not base his article on mere theory; he has written from actual experience with portable sets drawn from many and long-extended tours by automobile and pleasure boat.

* *

ON page 279 of our March issue POPULAR RADIO inadvertently stepped on the toes of our friends of the Western Union Telegraph Co. The trouble-making sentence read:

> "Attributed to radio competition, cable rates have been reduced for the first time in forty years."

WHILE the above observation is technically unassailable, the question may be properly raised as to just how authoritatively and by whom the change in cable rates has been "attributed" to radio competition. So, for purposes of accuracy, we quote below from a letter received from Mr. H. C. Hamilton of the Western Union, even though the quotation makes us violate our inviolable rule against that anathema of all editors, the "free write-up":

* *

"IN December, 1911, the cable companies inaugurated the cable letter service and the week-end letter service, both of which gave the public a lower rate for two entirely new and much needed cable services. In April, 1923, the 25-cent a word rate for fast cablegrams was reduced to 20-cent per word beween here and England."

* *

THE "reformer" has now made his appearance within the realms of the broadcasters. It was inevitable.

* *

AND like all of his meddlesome kind, his purpose is to force his tastes and his ideas and his theories upon the rest of us—whether we like them or not.

* *

THE latest "reformer" of radio broke into the limelight perhaps more spectacularly than he anticipated when he, as the secretary of the "Keep-the-Air-Clean-on-Sunday Society" of New York (which was later reported as having twenty members) protested to station WMCA against the "degrading" and "defaming" of the ether by broadcasting on Sundays such profanities as popular music!

* *

AND as a hint of what might be expected if WMCA did not reform its ways, the writer and the "others" (meaning presumably his associates) threatened to "press the matter with the new radio commission."

* *

IT happened that the particular program feature that inspired this reformer's ire was "Roemers' Homers," sponsored by Mr. Milton M. Roemer, a New York business man.

* *

INSTEAD of indulging in controversy, Mr. Roemer appealed direct to the radio audience. "What kind of Sunday programs do you want?" was the substance of his appeal. "We will try to give you the kind of Sunday program that you yourselves elect."

AND the immediate response to this query was an avalanche of thousands of letters, augmented by scores of telegrams and telephone calls, practically all of them urging the continuance of the popular program!

* *

POPULAR RADIO has long believed and often reiterated its opinion that the radio audience should get and will get pretty much the sort of radio entertainment that it wants. Undesirable features are tuned out too easily to make any other course successful.

* *

UNDOUBTEDLY there is a large and eminently proper demand for the broadcasting of Sunday church services—particularly on Sunday mornings. POPULAR RADIO believes that this demand should be met.

* *

BUT there is even a larger and just as proper a demand for Sunday program features that are *not* of a religious nature —particularly on Sunday afternoons and evenings. POPULAR RADIO believes that this demand should also be met.

* *

THE indiscriminate broadcasting of all kinds of religious propaganda has been so vastly overdone as to assume the proportions of a public nuisance. Only recently has the radio worm finally turned and demanded—and gotten—more popular programs on Sunday afternoons.

* *

IT is probable that the nature of the Sunday religious programs has kept silent on this day millions of receivers that would otherwise have been in operation. The loss has been the fan's, the broadcaster's and the radio industry's alike.

* *

BY all means maintain all the religious programs that the fans want. But by all means maintain all the popular programs that the fans want, too!

* *

THE most efficient and professional installation of a receiving set in a motor car that has yet come to the attention of POPULAR RADIO will be described in the next issue of this magazine.

Kendall Banning

Editor, POPULAR RADIO.

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The Most Valuable Information for the Progress of Radio

"Aside from the strictly technical journals, I find POPULAR RADIO *gives me the latest and most accurate knowledge of recent radio developments. Its editorial policy, too, keeps abreast of the times. Undoubtedly,* POPULAR RADIO *is contributing some of the most valuable, as well as interesting, information for the progress of the science of radio."*

PRESIDENT, ALL-AMERICAN
RADIO CORPORATION.

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General Electric

Radio Combines Its Senses of Hearing and Seeing

Step by step radio develops its senses—the equivalent of the five senses of mankind. To the perfected ear of the microphone is now added the eye of the motion-picture camera. By this new system of speaking motion picture, Mr. Kolin Hager, studio manager of WGY, is pictured on the film as he speaks into the microphone; the two records are joined on the same strip of film. The camera is motor-driven, to keep the records exactly in step.

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Popular Radio

VOLUME XI May, 1927 NUMBER 5

Static's New Job as Life-Saver

The ingenious combination of mind and machine that is at last making intelligible to man the warnings of the direction and approach of one of the most common and disastrous forms of the "acts of God."

By COMMANDER S. C. HOOPER, U.S.N.

"The winds may come and the winds may go,
"But where they go to I don't know."

A FEW years ago this couplet never failed to bring a laugh from the footlights, but to-day, based on revolutionary experiments conducted by the Navy, the modern version should read:

"Cyclones, hurricanes, blow your worst,
"With static bearings we'll get there first."

No more need the mariner blunder into the path of the devastating hurricane of the Caribbean, jeopardizing the safety of his ship and the lives of his crew. No more need there be the loss of a single life when the raging winds, gathering fury as they go, vent their wrath on the coral islands of the West Indies and the populous coasts of our own country.

For while the home-loving public, untouched by the tragedy of a hurricane, peacefully sits by its radio-side, damning static for ruining a musical evening; while the greatest radio minds all over the land have sought a means of subduing or controlling static, modern science, like a fairy godmother, has waved her magic wand and we learn that static, erstwhile step-child of the ether, is a very useful Cinderella indeed.

It has been proved that static is ever screaming a raucous warning and pointing unerringly toward the path of the onrushing storm. It is as if the myriad souls who have met the vengeance of the hurricane are banded together in a spirit choir to show the way to safety.

Meteorologists have long been interested in the relation of static to storms, but it remained for an officer of the United States Navy, Lieutenant E. H. Kincaid, to evolve the theory that the strength of the static is proportional to the rate of change of pressure, it already being a known fact that the static emanating from an intense cyclonic area is greatest at or near its center.

The manner in which Lieutenant Kincaid made this discovery, which bids fair to become another boon to humanity brought forward in this decade, and the ingenious method employed to convert this theory to practical use, are of more than passing interest.

For two years Lieutenant Kincaid was the navigating officer of the *U. S. S. Kittery*, a small Naval auxiliary making regular trips between Hampton Roads and the West Indies. During these cruises he noted that the radio operator proved a fairly accurate static barometer. On each occasion when the operator complained of heavy static the weather map showed an area of changing pressure between the *Kittery* and the radio transmitting station with which he was communicating. This recurrent condition led to the belief that there was a definite relation between static and changing pressure.

Other ships had experienced this same static condition, but were content to wait until reception was good and thought no more of it. But Kincaid thought more of it—he thought a great deal of it. In fact, he thought so much of it that he despatched a radio to the Navy Department asking that a radio compass be installed in the *Kittery* on her return to Hampton Roads. He was convinced that this was a study well worthy of investigation. If static insisted on impinging itself upon the eardrums of his operator he would not treat it as an unwelcome guest as others had done. Presuming it had a story to tell he was more than willing to hear it.

When the *Kittery* made her next trip she was equipped with a radio compass of the latest design. And as if the Gods of Chance had stacked the cards in Kincaid's favor, he was given his great opportunity on this voyage to prove his theory beyond the question of a doubt. For while the *Kittery* was throwing off her mooring lines from the dock at Hampton Roads on July 15th, angry storm clouds were gathering in the dol-

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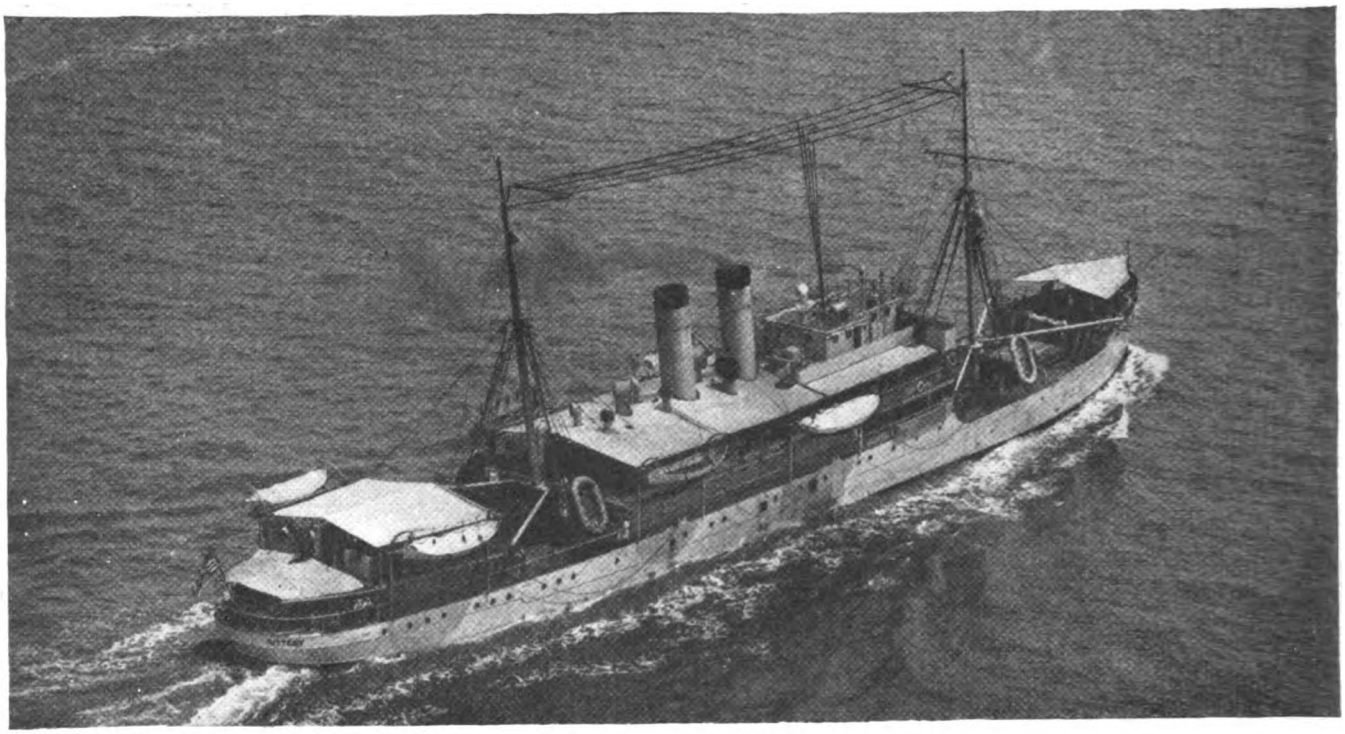

U. S. Navy Photo

THE SHIP THAT WAS SAVED BY STATIC

Over this antenna on this small naval auxiliary vessel, the U. S. S. KITTERY, *came the static signals that gave the navigating officer an idea—an idea that is converting the mariners' conception of static from that of enemy to friend and that has already resulted in the saving of many human lives.*

drums. As the little vessel nosed out of Cheasapeake Bay the evil winds had mobilized to the storm king's call and were even then beginning their horrific sweep of death and destruction in what was later named the Nassau hurricane because of its devastating effect upon that island.

Lieutenant Kincaid reasoned that if the static were actually greatest in the center of the hurricane then the radio compass would show a maximum when pointed toward its center and a minimum on such maximum ninety degrees from its center. The radio compass coil was turned by hand at the rate of ten degrees a minute, thereby covering the entire circle in six minutes. The position of the coil at the point of maximum static should indicate the direction of the storm center.

While passing through Crooked Island Passage there were indications in the compass of heavy static in the direction of the Lesser Antilles. It was later proved that this was the position of the Nassau hurricane at that time. The *Kittery* continued to plot the course of this hurricane and the following day, July 24th, put in at Port au Prince, Haiti, as the cyclonic disturbance passed to the northward of Santo Domingo.

Day by day as the *Kittery* was returning to Hampton Roads the track of this hurricane was plotted and verified. Prior to arrival the results were analyzed and it appeared that "the reason the association of static to changing atmospheric pressure had not been definitely established before, was due to the comparative mildness of the static, especially the grinder type, which is generated in sufficient volume only in the *center* of hurricanes for bearings to be obtained without the use of precision instruments." Static, which is so annoying in receivers, is generally believed to be very strong, but actually, in relation to man-made electricity, it is quite faint under nearly normal conditions. This indicated that the personal error of the operator would have to be reckoned with and showed the need of a static recording instrument to obtain precise results under all conditions.

It had been noted while making experiments with the Jenkins radio weather map recorder that static, as well as any other disturbance in the ether, left its mark on the map. This fact made it possible to utilize the instrument as a static graph recorder, and on the September trip of the *Kittery* it was hooked up to the radio compass with surprisingly good results. The circular static graph shown on the facing page, is a reproduction of the data recorded by the Jenkins instrument. These graphs give little more than the quantity of static in any particular direction. It remains for an additional attachment which the Bureau of Engineering, U. S. Navy, and other interests are developing, to give the relative intensity of the individual impulses.

Once again Fate dealt to Lieutenant Kincaid from the bottom of the deck, for the month of September, 1926, was marked by an unusual degree of storm activity in tropical regions of the North Atlantic. In addition to the hurricane which devasted Miami on the 18th, there were no fewer than four other storms of tropical origin. The tracks of the Bermuda hurricane, the Swan Island disturbance and the Miami hurricane were faithfully and accurately plotted by means of the static graph instrument. Being thus forewarned, the *Kittery* by artful dodging evaded every blow and carried out her schedule on time.

Many others were not so fortunate. The American steamship *Haleakala* and the British steamship *Loyal Citizen* were lost with all on board; in addition, an appalling number of smaller vessels were sunk or helplessly beached while lying in presumably sheltered harbors.

Yet luck served no part in carrying the *Kittery* safely through this storm; it was the practical application of a scientific theory that enabled this little vessel to ride out the hurricane without any discomfort.

"Having plotted the position of this hurricane twice daily," writes Lieutenant Kincaid in his official report, "it was predicted that the center would pass suffi-

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ciently to the northward of Cape Hatien for the *Kittery* to reach that port according to schedule. This prediction was correct. However, all precautions were taken for encountering heavy weather.

"The ship left Cape Hatien before dark and rode out the storm in comparative safety in the lee to the northward of Tortuga Island, which juts up abruptly from the sea to a height of 1200 feet, with deep water close up to it. The *Kittery* steamed in the lee all night, where the apparent strength of the wind was reduced to gale force and the seas were negligible, although in the upper air above the island the wind could be seen by the cloud movement to be of hurricane violence."

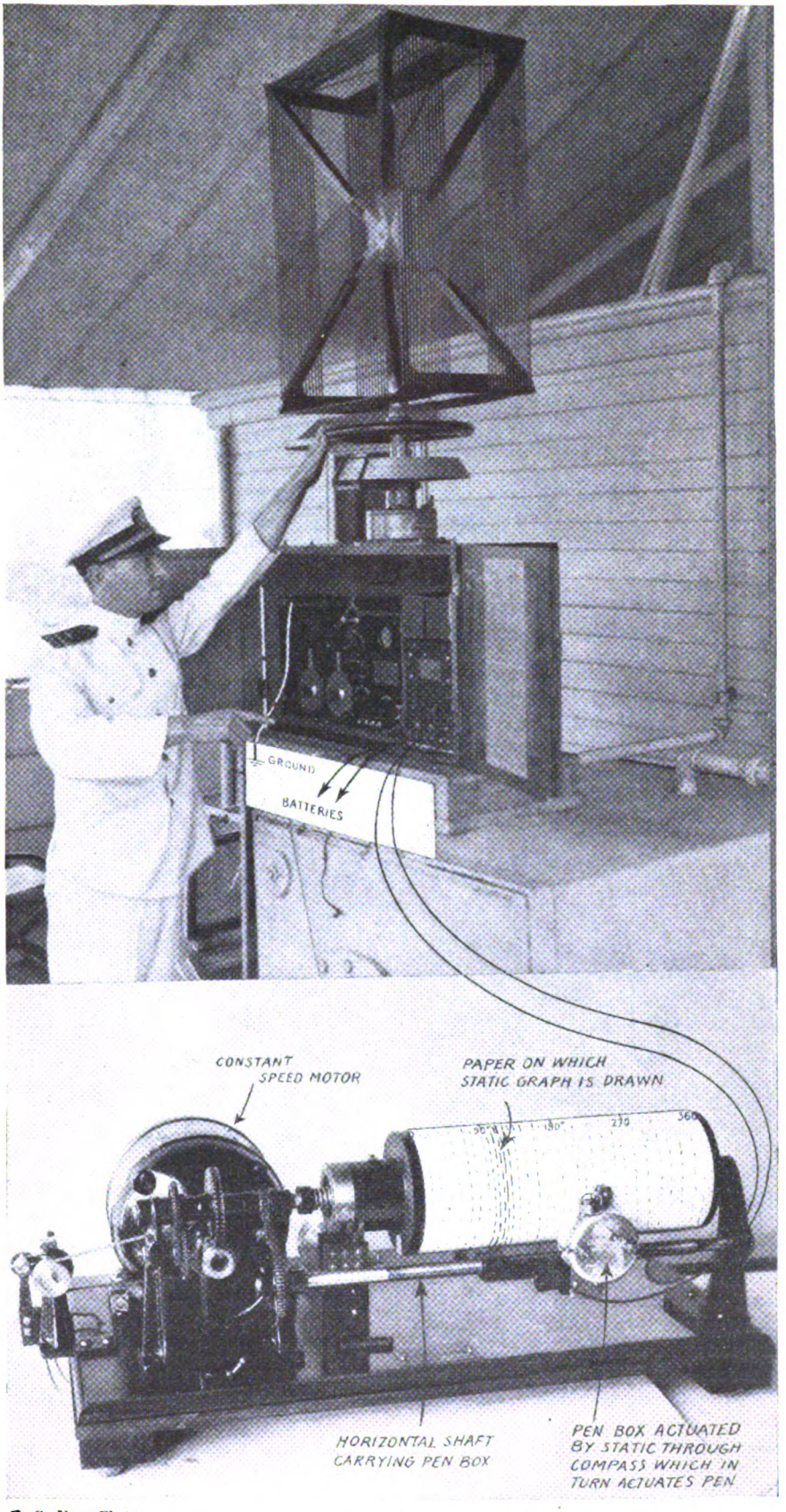
On this occasion the southerly winds were so strong that innumerable birds, blown from their nests in Haiti, became attracted by the ship's lights and fell exhausted upon the decks. Their piercing shrieks could be heard above the violence of the winds.

There is an old seagoing superstition that whistling about the decks will cause the winds to spring up. There is no record of Kincaid having whistled on these trips, but nevertheless he must have had some sort of understanding with the God of Storms, for the weather was made to order for him on every occasion. He had but to show himself in the Caribbean when along came a hurricane. Even on his honeymoon which followed shortly after the Miami disturbance had subsided, a playful hurricane disported itself about the ship on which he was making his wedding trip to Bermuda.

This personal attraction for hurricanes would make Kincaid a doubtful asset as a shipmate, yet had the *Kittery* not encountered all these typical disturbances within such a short interval of time, it might have required several years of observation to obtain adequate data on his theory. As it happened, conclusive proof was happily derived from two successive voyages.

And now, when vessels are equipped with radio compasses and static graph recorders, they can, by application of this theory, readily anticipate the hurricane's track and thereby avoid its fury. The element of surprise and unpreparedness which has been the primary cause of previous disasters would be entirely eliminated.

The hurricanes of the late summer and fall invariably originate in the Atlantic doldrum near the west coast of Africa and move in a general westerly direction. It is proposed to utilize existing Naval radio compass stations in practicing the picking up of directional static and if satisfactory results are obtained the next logical step would be to erect an outpost of such stations on several islands of the



U. S. Navy Photo

HOW THE MOVING FINGER OF STATIC WRITES ITS WARNING

At the top is shown a standard type of compass connected to its receiver and amplifier. Two leads run down to the Jenkins "static recorder," operated by motor, that prints a graph of the static impulses on the rotating cylinder. These records give warning of approaching storms and even go so far as to tell the direction from which they may be expected to break and their approximate intensity.

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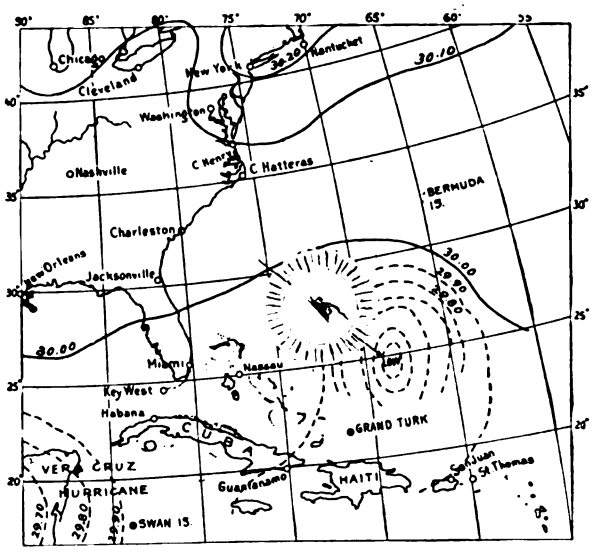
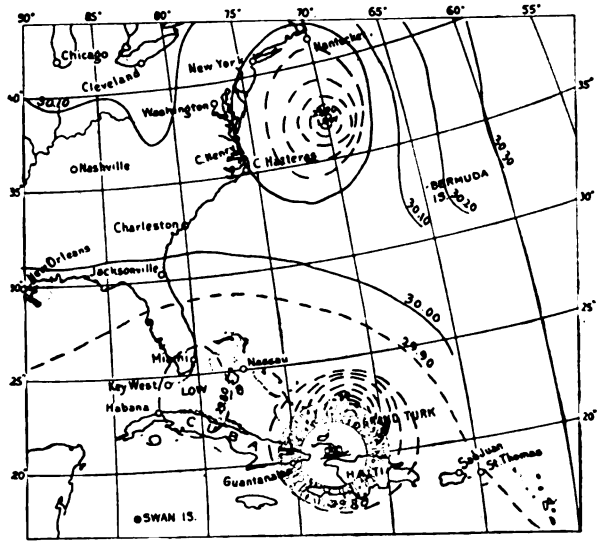


WHEN A STORM IS FORMING AND—

The curved lines on this weather map show the location and general character of the atmospheric disturbance; the effect of it on the static record is indicated on the raylike circle around the ship.



—WHEN THE STORM BREAKS

Note the concentration of the storm area and the corresponding effect on the static record. (This record was made September 16, 1926, while the U. S. S. KITTERY *was riding the Florida hurricane.)*

West Indian group in a line between Trinidad and Porto Rico. These stations would take simultaneous static bearings of the hurricane's center almost at its inception, and in any event before it reaches inhabited islands or the usually traveled shipping lanes. By means of triangulation the path and progress of the storm would be readily obtained.

Radio warnings based on these observations would then give all vessels ample opportunity to seek a haven of refuge removed from the track of the hurricane and would permit those on shore to make such preparations as are practicable to insure the minimum property damage. In the West Indies there are thousands of natives who place their entire dependence in the trade winds to assist them in making their living. The fishermen of these islands rely upon the winds almost to a point of religion. They may be seen bound out to sea at daylight sailing wing and wing on the land breeze and returning with the sea breeze as the sun is getting low. Their daily excursions are as regular as the ebb and flow of the tides. Every hurricane that comes along takes a tremendous toll of these natives. The same applies to the sponge divers of the Bahamas and all others who depend on the sea for their livelihood. Accurate hurricane warnings would be most valuable to the heavily populated areas bordering the southeast coast of the United States which even yet has not recovered from the ravages of the recent hurricane.

The Weather Bureau has done excellent work in locating storms and in predicting their path by means of meteorological observations. When the static method is placed in operation it will, according to those who are developing it, substantiate this Bureau's reports and make certainties of predictions.

Investigations of static relative to storms have been pursued for many years by this country as well as the nations of the world. As early as 1901, observations of static were used by at least one meteorological observatory as a supplementary means of forecasting certain types of weather. In 1921 the Navy attempted to make use of static bearings by utilizing the radio compass stations along the southeast and gulf coasts of the United States with sufficiently good results to show that this was practicable. However, communication between these stations was difficult and the work was finally abandoned due to lack of facilities and to other more pressing demands.

Interest was revived upon the advent of improved instruments and more reliable static graph recorders, and the impetus derived from the *Kittery's* experiments during the past year will result in unflagging effort on the part of the Navy and other Government departments to convert these theories to practical use for the good of mankind.

For Operating the Browning-Drake Receiver Without Batteries

In the next number of POPULAR RADIO*—for June—will appear another constructional article by Glenn H. Browning and Dr. Frederick H. Drake, the inventors of the famous circuit that bears their names. This forthcoming contribution will follow up their article in the April issue; it will give the full constructional details of an "A," "B" and "C" power-pack for the complete operation of the Browning-Drake receiver without the use of batteries.*

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¶ This is the time of year to get ready the compact receiver that you can carry about with you on your summertime jaunts; here are some helpful hints for going about it

EFFICIENT AND PRACTICAL

PORTABLE SETS

By WILLIAM F. CROSBY

MODERN radio equipment, 1927 model, lends itself more readily than is generally supposed to summertime uses, on the automobile camping trip, on the hike or afloat on a motor boat cruise.

This is true, of course, of home-made sets as well as of commercial portable receivers. There are several small portable outfits which will receive broadcast programs satisfactorily—and with proper volume over considerable distances. Most of these sets, however, are better adapted to motor boats and automobiles, as their weight usually precludes the possibility of their use on hiking trips.

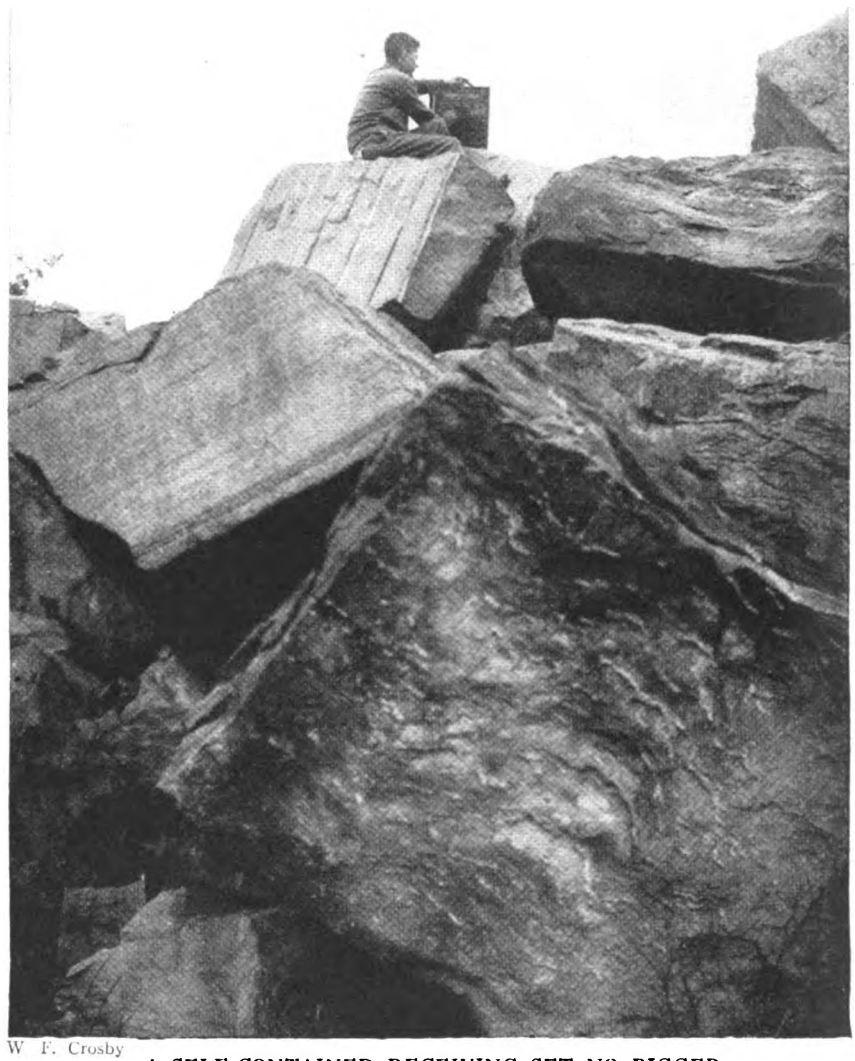
The home-made radio set, with from one to three vacuum valves, is probably better adapted to the type of vacation on which equipment must be packed over rough country. These sets may be built up in extremely small cabinets and the batteries (the most weighty part of the equipment) may be arranged in a separate container, thereby permitting the load to be more equally distributed.

In equipment of this type it is best to disregard completely the use of a loudspeaker. The ungainliness of such equipment, as well as its fragility, makes its transport on foot an extremely difficult undertaking at best. Of course, the smaller the set, the lighter it will be, and as even a one-valve receiver will permit the use of several pairs of headphones, it is apparent that such an arrangement is ideal when weight is the prime consideration. Furthermore, the headphones may be easily packed away in a blanket roll and will add but a few ounces to the total weight.

Another smaller set for the hiker, and a set that is extremely easy and cheap to make, is the crystal set, consisting of a variometer, a fixed condenser or so, a crystal detector and a pair of headphones.

As the headphones can usually be taken apart, a pair of campers need not burden themselves with an extra pair of phones, but may share the two ear pieces between them.

This set may be built in a box just large enough to hold the variometer and detector, with binding-posts for the antenna, ground and the headphones. No batteries are required for its operation and the weight may be reduced to almost nothing. For all practical purposes an antenna about 75 feet long will do the work. Usually the range of such a set is a maximum of twenty-five miles, but there are instances of much greater distances being covered. Of course summer weather will cut this down somewhat anyway, and by assuming twenty-five miles as the greatest distance for the set, we will prevent disappointment. Everything depends on the crystal in the detector and the better this is, the better the set will work.



W. F. Crosby

A SELF-CONTAINED RECEIVING SET NO BIGGER THAN A SATCHEL

The compact little instrument pictured above is a portable superheterodyne with self-contained batteries and reproducer; it may be carried into almost any accessible place and may be set up and put into operation in an instant.

For a trip into the wilds, either by pack horse or afoot, one of the best pieces of equipment is a single or two-valve set, operating entirely from dry-cell "A" batteries and using the smallest kind of "B" batteries. In fact, with modern low-amperage vacuum valves it is practical to use a small 4½-volt "C" battery to replace the usual cumbersome dry "A" batteries; this will not only save several pounds in weight, but it will also reduce the size of the complete outfit. Such a small battery will last several weeks, at the least, in normal operation; if an extended trip is to be

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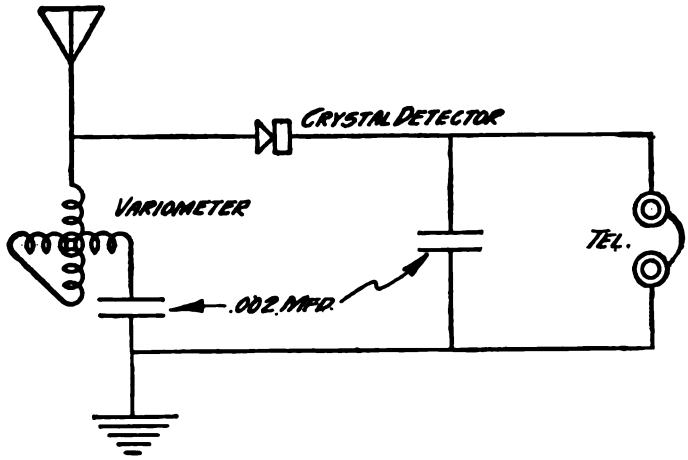
W. F. Crosby

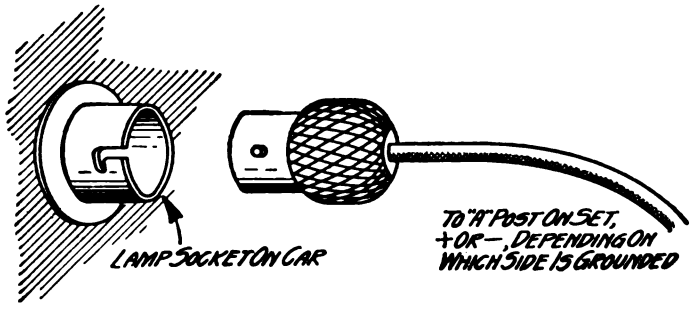
HOW TO RIG UP A TEMPORARY ANTENNA IN A TREE TOP

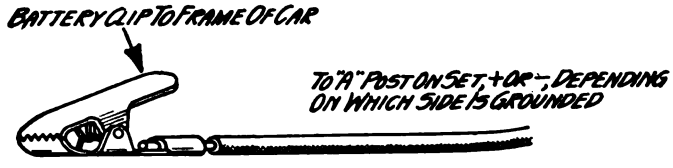
Just tie a stone to the end of a rope and throw it over a convenient branch; then tie the antenna wire to the rope and pull it up. Such an antenna is suitable for any of the sets described in this article. However, under particular circumstances in which hikers or tourists frequently find themselves, other types of antennas may be found more convenient or practicable. Several such cases are described in the text of the article.



A SIMPLE CRYSTAL CIRCUIT FOR A PORTABLE SET

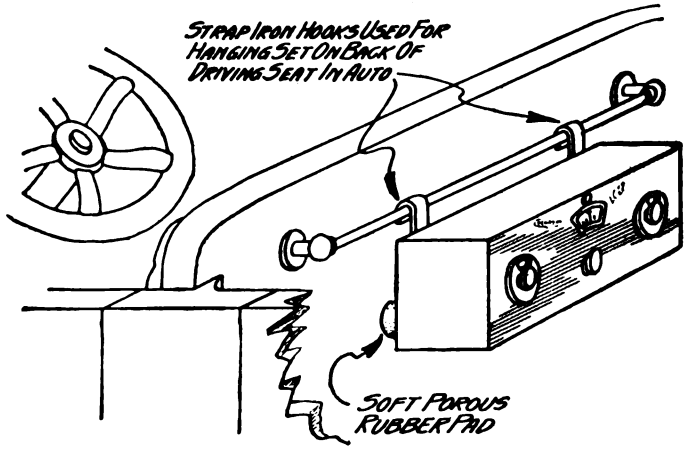
A variometer and two fixed condensers with a crystal detector and mounting may be placed in a small box and carried by the hiker.





HOW TO TAP THE MOTOR CAR BATTERY

With these two simple connections the storage battery in an automobile may be used for supplying current to portable tube sets.



ONE WAY TO MOUNT A RECEIVER IN AN AUTOMOBILE

Most five-passenger cars have a robe rail on the back of the front seat; it is a simple matter to install a receiving set on this rail, as indicated in the drawing above.

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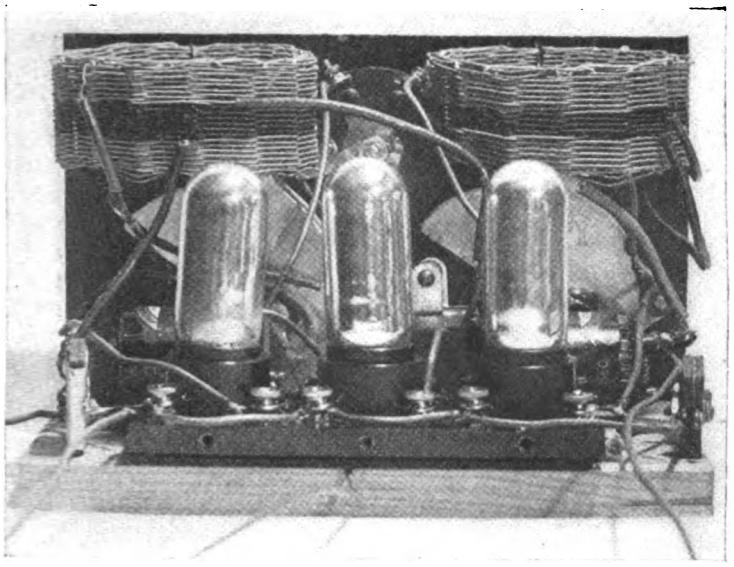


A POPULAR PORTABLE

This portable three-tube set employs a straight regenerative detector and two stages of low-frequency amplification with UX-199-type tubes. It may be installed in a simple box that also holds the batteries, as shown in the illustration at the right.

W. F. Crosby

taken, it is a simple matter to carry two or three spares along as replacements. Even with this the size and weight will be below that of the ordinary battery equipment.

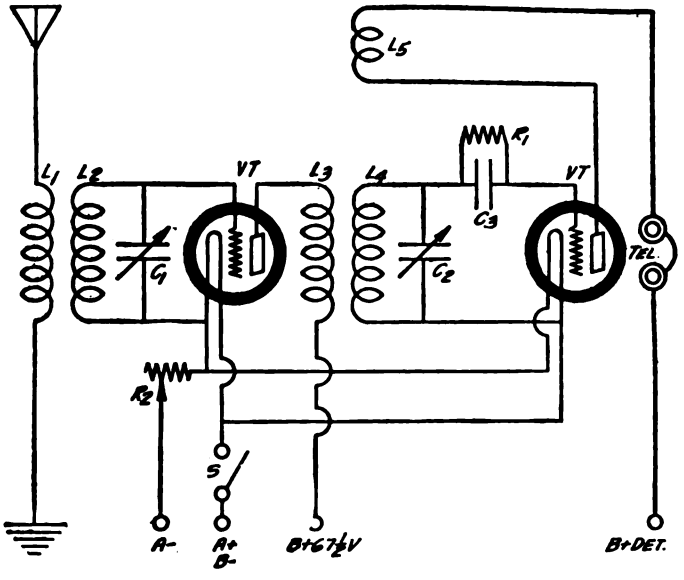
The circuit may take any one of several different forms; it may be the ordinary regenerative detector with one stage of low-frequency amplification or it may be a reflex circuit in which the first valve acts as both low-frequency and a high-frequency amplifier with the second valve acting as a detector. This type of set, though, is apt to be unstable unless it is carefully designed. Probably the best arrangement is the circuit that embodies one stage of tuned high-frequency amplification with a regenerative detector. This will give plenty of volume for the headphones and will also prove to be sufficiently powerful to bring in distant stations under adverse conditions. Of course, a third valve may be added as a single stage of low-frequency amplification, but the added volume may not be necessary or desirable.

If you will take the trouble to look around the radio stores you will find that there are many makes of small instruments which will be suited to the assembly of such a diminutive receiver. Last year, the author made a three-valve reflex receiver, using UX-199 type tubes on a panel only 8½ inches wide by 5 inches high. The panel of this little set contained the two tuning controls, a rheostat knob, a jack for the headphones and the antenna and ground binding posts. A practical cabinet was made from some soft lumber and given two coats of dark green paint.

The set was placed in the upper half of this cabinet and the four 22½-volt "B" batteries and the 4½-volt "C" battery were placed below. Since UX-199 type valves were used, the "C" batteries were used as "A" batteries and lasted all summer.

All connections except the antenna and ground wires and the headphones were contained inside the set. The shelf on which the apparatus was mounted was cut away at the back to permit flexible rubber-covered leads to be brought down to the batteries.

The top of the cabinet was hinged so that the vacuum valves could be easily reached, and it was arranged to fasten down when closed. A handle on top permitted the set to be carried about



THE SCHEMATIC CIRCUIT FOR A SIMPLE TWO-TUBE SET

This drawing gives the connections for one stage of high-frequency amplification with a regenerative detector. It employs small valves that may easily be built up into a portable receiver.

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easily. The entire front was hinged so that it would come down and form a sort of desk; to this was secured a piece of paper which acted as a log sheet. The tubes were mounted on a flexible base; it was not necessary to remove them. In fact they were far safer in the sockets than they would have been kicking around with the rest of the camp duffle.

The antenna used with this outfit consisted of 100 feet of enamelled, stranded wire, which worked well without insulators of any kind, as the enamel on the wire acted in that capacity. This fact alone saved considerable time in erecting the antenna, and it also saved some weight. Instead of going through the tedious process of throwing a wire over the branch of a tree or (worse yet) of climbing to the upper branches to make the wire secure, the antenna wire was simply run through the woods as far as it would go and then fastened to some convenient sapling, possibly six or seven feet above the ground. The sapling was bent slightly before the wire was made fast and when allowed to straighten up, it pulled the wire up and kept it taut.

Incidentally, this wire came in handy on several occasions as a suitable place to dry out bathing suits or to air the camp bedding!

All sorts of "grounds" were tried. Spikes were driven into trees, short wires were thrown into nearby bodies of water, a length of pipe was driven a few feet into the earth and even a counterpoise was tried. In one instance an automobile was used as a counterpoise—and it worked surprisingly well at a distance of about 150 miles from New York.

The counterpoise is probably the best bet of all for the varying conditions of camp radio work. It necessitates, however, the transportation of another coil of wire, and it is questionable whether this is the easiest to handle, or a short length of wire which may be thrown into the water. As most camps are located near water of some kind, it is an easy matter to secure a good "contact" in this way. If a dry camp is made, though, the antenna wire may be cut in half and the counterpoise arrangement resorted to. If the camp is a short distance from some broadcasting station, it is often possible to use the body of the automobile as the antenna and then drive a tire iron or some other handy piece of metal into the earth to form the ground side of the circuit.

In case the automobile is used for a camping trip, the problem of weight is simple, for it is safe to assume that the set will never get far away from the machine. In fact, it is easy to hang it on a small bracket which can be hooked over the robe rail on the back of the driver's seat.

Regular "B" batteries may be carried in a box under the radio set and the 6-volt storage battery used for starting and lighting may be tapped as a source of "A" supply. Most automobiles have one side of this battery "grounded" to the frame of the car, and in every one so far examined this has been found to be the positive side. As most radio sets have their negative "A" battery lead grounded, care must be used to see to it that there is no direct short circuit if the body of the car is used either as an antenna or counterpoise.

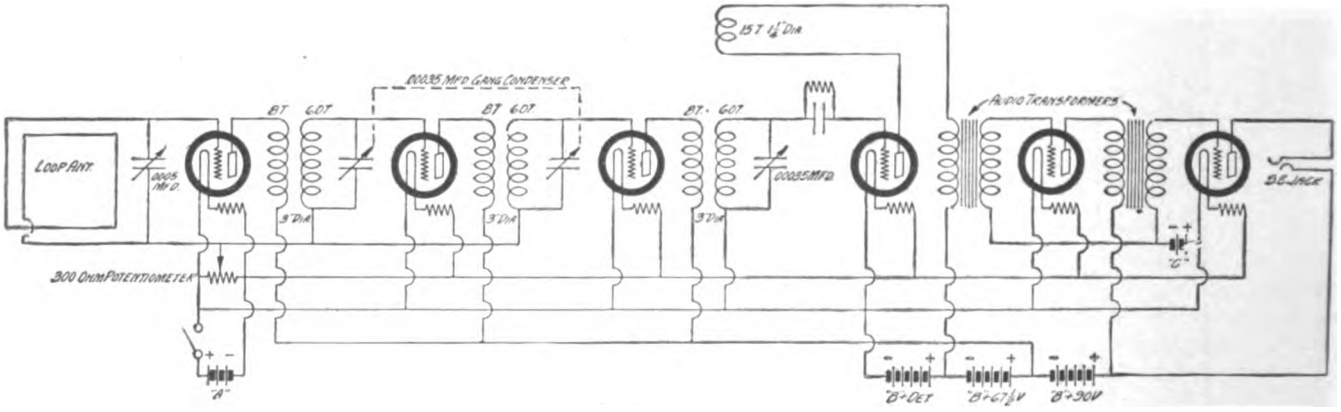
Some of the larger cars have locker arrangements where small sets may be installed and then locked up securely. Under such circumstances the body of the car may be used as a counterpoise, while an insulated wire arranged as an "inside antenna" will form the other half of the circuit. Such a scheme has been successfully used on several cars.

In one unique installation, the radio receiver, the loudspeaker and all the batteries were arranged in a big box which was secured to the running board of the car. This was a two-story arrangement, with the set above and batteries below, and when it was not in use it could be closed and securely locked. The owner claimed that his set probably had the privilege of hearing more broadcasting stations than any other set in the country, for he was both an inveterate tourist as well as radio fan, and he carried his call book with him in order to keep track of nearby broadcasters. When he was in the vicinity of a station he had never heard before, he promptly pulled up along the roadside and tuned in. His log book contained most of the stations of the country and would be the despair and envy of any "DX" radio enthusiast.

Hence, summertime radio is a good deal better than it used to be; with a good set many an enjoyable evening may be spent in some otherwise lonely camp, far from civilization. In addition to the usual program features—music and humor—you will be able to keep in touch with the world's news events. And if you are so unlucky as to strike a stretch of rainy weather, radio will be a big help in keeping the camp company in good cheer. For many an otherwise delightful camping trip has ended in a row because of the weather's pranks.

Try radio on your trip this summer—and see what happens!

Because many broadcasting stations have increased their power to the point where their signal strength is higher, even at a distance, than is the atmospheric "noise level," the problem of the fan has been simplified. Also, broadcasting stations are so numerous now that almost any location is within "summer" reception range of half a dozen stations or more.



A GOOD CIRCUIT FOR A RECEIVER THAT IS USED IN AN AUTOMOBILE

The electrical connections shown above are for three stages of high-frequency amplification coupled to a regenerative detector and two stages of low-frequency amplification. The second and third stages of amplification are tuned with a double condenser. The regeneration in the detector circuit greatly adds to the sensitivity of the set. This feature, together with the simplicity in tuning and the easily handled loop antenna employed, makes this set an ideal one for installation in a car.

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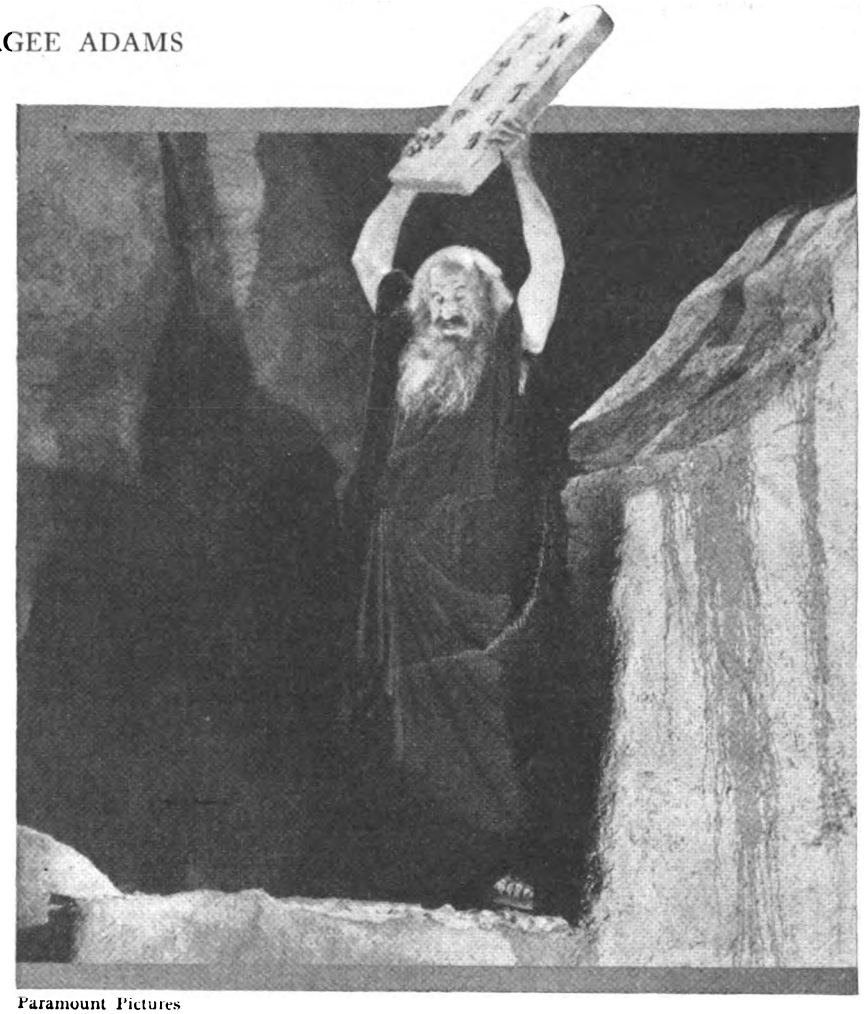
The XVIII Commandments of Radio

By CHARLES MAGEE ADAMS



Paramount Pictures

RULE 1. Should your friend, while visiting you, remark (as some uncouth persons will) that his receiver is much superior to yours, agree without dispute or reservation; explain modestly that your own receiver is merely a "tolerably good job."

RULE 2. Never offer suggestions regarding the operation of the friend's receiver, or evince the slightest desire to operate it. On the other hand should a friend who visits you manifest a wish to operate your receiver, surrender the dials to him immediately.

RULE 3. If a friend states that his receiver brings in stations at greater distances than your own, accept the assertions with complete credulity, not offering in rebuttal any facts regarding the performance of your own receiver.

RULE 4. Should a friend's wife, while visiting you, inadvertently continue talking while you attempt to tune in a distant station, thereby causing the call letters to be indistinguishable, do not request her to cease speaking; on the contrary, extend your courtesy to the point of encouraging her to continue her discourse.

RULE 5. If a friend's child ruins your new cone speaker in a youthful spirit of play, remark nonchalantly that "That is nothing—nothing at all!"

RULE 6. In the event that you are favored above your fellows in receiving Europe, say nothing about it the next day at your office or club; remark merely that you found the reception tolerably good last evening.

RULE 7. Should your friend indicate that he wishes advice in the selection of a receiver, or assistance in correcting defects, hesitate before tendering aid.

RULE 8. As women express the inexplicable idiosyncrasy of preferring mere programs above the accepted practice of ascertaining how many stations can be logged during a given evening, you should yield to this peculiarity.

RULE 9. If your wife, while wearing the headphones, inadvertently shouts, do not comment on the fact; while wearing the phones yourself, keep your voice modulated to refined quietness—particularly when announcing the reception of a distant station.

RULE 10. If your wife betrays displeasure when you spill battery acid on the living-room rug, maintain a gentlemanly silence.

RULE 11. A refined radio enthusiast will always tune in programs that please other members of his family, completely disregarding his own wishes.

RULE 12. If your maid or a member of your household thoughtlessly causes your tubes to become burned out by crossing battery wires or otherwise disturbing your receiver while cleaning it, never mention the fact.

RULE 13. Should a service man or other trades person whom you summon to correct defects, state that you need new tubes or batteries, immediately order the accessories mentioned, without question; at the same time refrain from keeping any check on the time used by the fellow in remedying the trouble.

RULE 14. When static, the squeal of a neighbor's receiver or the noise of his heating pad blots out the call letters of a station to which you are listening, the correct expression is, "How exceedingly unfortunate," spoken in a tone of mild humor.

RULE 15. Should an announcer to whom you are listening make a remark which is ostensibly intended to evoke mirth, laugh in a spontaneous manner.

RULE 16. Should the sponsors of a program suggest that they would welcome letters of comment, write immediately—expressing refined appreciation.

RULE 17. In the remote event that you hear the same dance number more than once during the same evening, refrain from the boorish practice of tuning it out.

RULE 18. The perfect radio gentleman will give close and careful attention to all broadcast announcements that are calculated to arouse a desire for certain products and commodities offered for sale, and act immediately on the suggestions of the broadcaster.

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From a photograph made for POPULAR RADIO

THE PRE-SELECTOR IN OPERATION

FIGURE 1: *The instrument described in the following article will make* ANY *receiver ultra-selective—and will even improve the selectivity of an already selective receiver without decreasing sensitivity or volume.*

HOW TO ELIMINATE INTERFERENCE WITH

The PRE-SELECTOR

By S. GORDON TAYLOR

This unit is designed for use with *any* receiver, to overcome the general interference suffered as the result of the large number of broadcasting stations operating at the present time. It provides, in addition to other advantages, a degree of selectivity heretofore obtainable only with the finest superheterodyne receivers.

COST OF PARTS: *Not more than $33.00*

HERE ARE THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS RECEIVER—

A and B—S-M plug-in coils, No. 110A, equipped with coil sockets, No 515;
C1 and C2—General Instrument "Metralign" variable condensers, .00035 mfd.;
C3—Cardwell Balancet midget condenser; No. 613A;
C4—Any approved fixed condenser, with grid-leak clips, .00025 mfd. (Polymet condenser illustrated);
C5—Any approved fixed condenser, .0001 mfd. (Polymet condenser illustrated);
D1 and D2—Karas Micrometric vernier dials;
D3—Kurz-Kasch 1½-inch bakelite knob;
R1—Any approved rheostat, 30 ohms, equipped with knob (Carter rheostat illustrated);
R2—Any approved grid-leak, 4 megohms (Lynch grid-leak illustrated);
RFC—Precision high-frequency choke coil, No. 400;
S—Yaxley jack switch, single-pole, double-throw;
V1 and V2—Any approved cushion-type sockets (Na-ald sockets illustrated);
W—Cabinet (see Figure 10 for dimensions);
X—Bakelite panel (see Figure 6 for dimensions);
Y—Hardwood baseboard (see Figure 8 for dimensions);
Z—Bakelite binding-post strip, including six engraved binding posts (see Figure 9 for dimensions).

THE fly in the ointment of the radio enthusiast today is, undoubtedly, the interference between broadcasting stations that has resulted from the crowded condition of the ether, due, in turn, to the large number of stations that have started operation within the past few months.

In too many cases this condition prevents the full enjoyment of radio because the wavelengths of desirable stations are "blanketed" by the broadcasting of a powerful nearby station. To eliminate this trouble, fans have rushed toward the use of wave-traps of one kind or another. Such a device may be easily built at home for a few dollars and does prove helpful in most cases in

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eliminating the interference caused by a single station.

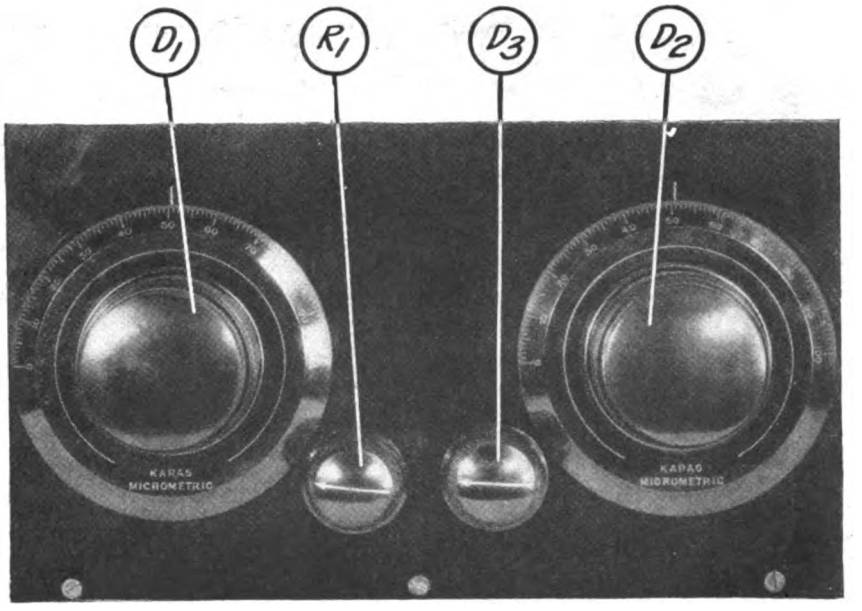
On the other hand, a wave-trap will eliminate only a single interfering station and has the disadvantage that it adds another tuning control to the receiver with which it is used.

POPULAR RADIO has believed for some time that some device could be designed that would present far greater advantages than does a wave-trap; its experiments have led to the developments of the unit described here.

The name "Pre-selector" has been given to this device; it is both appropriate and descriptive of the apparatus, because its function is to provide selectivity *before* the signals reach the receiver. All tuning is accomplished in the Pre-selector itself; the receiver controls need not be used, although full advantage is taken of the high-frequency amplification in the receiver proper.

The advantage of this arrangement over any type of wave-trap is evident. Instead of rejecting the signals from a single interfering station, as does a wave-trap, the effect of the Pre-selector is to reject signals from *all* stations other than the station to which the operator of the receiver desires to listen. In other words, the Pre-selector acts as an acceptor only for the signals from the single frequency to which it is tuned, and rejects signals from all other stations, no matter how powerful or close these other stations may be.

The Pre-selector functions as a frequency changer. That is, the receiver, with which this unit is to be used, is tuned to any wavelength above the broadcast band and the Pre-selector changes the frequency (wavelength) of all incoming signals to this wavelength. It is during this frequency-changing process that the selectivity is obtained.

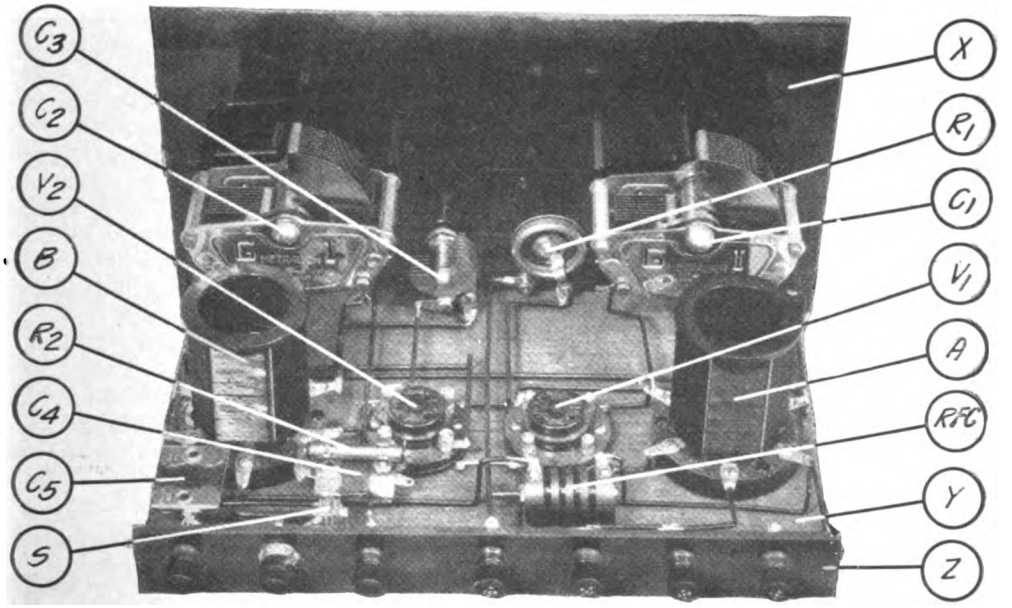


A FRONT VIEW OF THE PRE-SELECTOR

FIGURE 2: *The receiver with which the Pre-selector is used does not require tuning; when the receiver dials are set in resonance, the two large vernier dials on the Pre-selector do it all.*

The fundamental principle involved in this frequency-changing process is an old one, well known in experimental work.

It is difficult to be specific in describing a degree of selectivity. The mere listing of all the stations tuned in on a receiver operating in New York City, for instance, even though some of these stations be only 2 or 3 meters apart, means little to the man who is operating a receiver in Chicago. To say that the Pre-selector enables even a broad-tuning receiver to cut out Station WRNY in favor of an out of town station 10 meters lower in wavelength means much to the fan who lives in the upper west part of New York City—it almost means the achievement of the impossible. To the fan in some other city, however, this does not seem like much of a feat. The truth is that this station covers the whole dial on many receivers operated in homes along the upper part of Riverside



THE ARRANGEMENT OF THE INSTRUMENTS

FIGURE 3: *This view shows the compactness and simplicity of the unit. The "two plane" method of wiring as described in the text is clearly illustrated here.*

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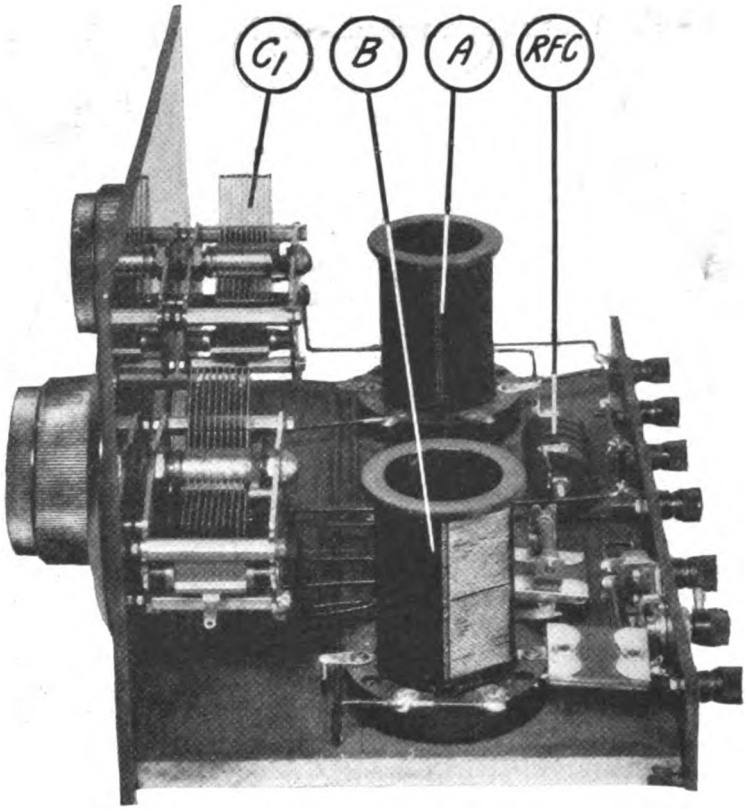

THE END VIEW OF THE PRE-SELECTOR

FIGURE 4: *Note that while the unit is compact, there is nevertheless plenty of room to get at the connections and thus make the job of wiring the instruments an easy one.*

Drive and the vicinity. But when the Pre-selector is used with these same receivers, this station can be cut out absolutely in favor of other local and distant stations that operate 10 meters away from the wavelength of this particular station.

Furthermore, the majority of receivers in New York City cannot cut out the local stations that operate on 315.6 meters, in favor of Pittsburgh, which is on a wavelength of 309.1 meters; in fact, many of them cannot completely separate a local station which works on 303 meters from the ones on 315.6 meters, unless an extremely short antenna is used. It is even more difficult to tune in between these to hear KDKA without interference from the locals. When the Pre-selector is used these feats are easily accomplished even when a large antenna is used.

Some Other Features of the Pre-selector

While extreme selectivity is the outstanding feature of the Pre-selector, it is not its only valuable property, by any means, as is shown in the following tabulation of this unit's merits:

1. It may be used with any receiver, from the old regenerative receiver with its detector and two stages of low-frequency amplification to the more modern receivers which include one or more stages of high-frequency amplification:*

2. It converts any receiver into a two-control set, regardless of the number of tuning controls on the receiver itself:

3. No change whatsoever is necessary in the wiring, location or connections of the receiver with which this device is to be used:

4. The Pre-selector permits the use of a large outdoor antenna, even in locations where the average receiver would require a small antenna in order to obtain any degree of selectivity:

5. It permits the use of a loop antenna with any receiver which is ordinarily capable of reception with a short antenna:

6. The inclusion of a sensitivity control and variable coupling in the antenna coil of the Pre-selector permits the operator to vary the selectivity to fit his requirements. The poorest selectivity obtainable with this unit is better than that obtained with the average receiver:

7. It increases the sensitivity of the receiver in many cases, and in any event, does not decrease the efficiency except in the case of some of the old type three-tube regenerative receivers that do not employ any high-frequency amplifier:

8. If it is desired to use the receiver alone, it is necessary merely to throw a switch which is included in the Pre-selector unit; this cuts the Pre-selector out of the circuit and transfers the antenna to the receiver direct:

9. The Pre-selector adds no appreciable drain on the batteries, as its filament consumption is only slightly more than 1-10 of an ampere and the plate current only 3 milliamperes:

10. The filament and plate current for operating the Pre-selector may be drawn from the same source that is used to supply the receiver:

11. Although UX-199 type valves are used, their filament current may be supplied from either a 6-volt or from a 4½-volt source. The resistance of the filament rheostat specified is sufficient to cut either of these supply voltages down to the required 3 volts.

How to Construct the Pre-selector

The front panel should first be prepared and drilled and the baseboard cut to the correct size, as shown in Figure 8. Complete specifications for size and for drilling the panel will be found in Figure 6.

The three condensers, C1, C2 and C3, and the rheostat, R1, may then be mounted in their proper positions on the panel. The position of the screw holes in the panel will indicate the positions in which to mount the condensers. The rheostat should be mounted with its terminals at the bottom.

It is a good plan to attach the panel to the baseboard at this time, in order to obtain the correct locations for the mounting screws on the edge of the baseboard. Then the panel should be removed from the baseboard and laid aside for the time being.

The binding-post strip, Z, should now be prepared, as indicated in Figure 9,

*Note.—This statement is based on tests made with 15 different receivers which included both home-made and factory-built models ranging from simple 3-valve sets up to the more modern 6- and 7-valve receivers.

¶ *The list of parts given above includes the exact instruments used in the set from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

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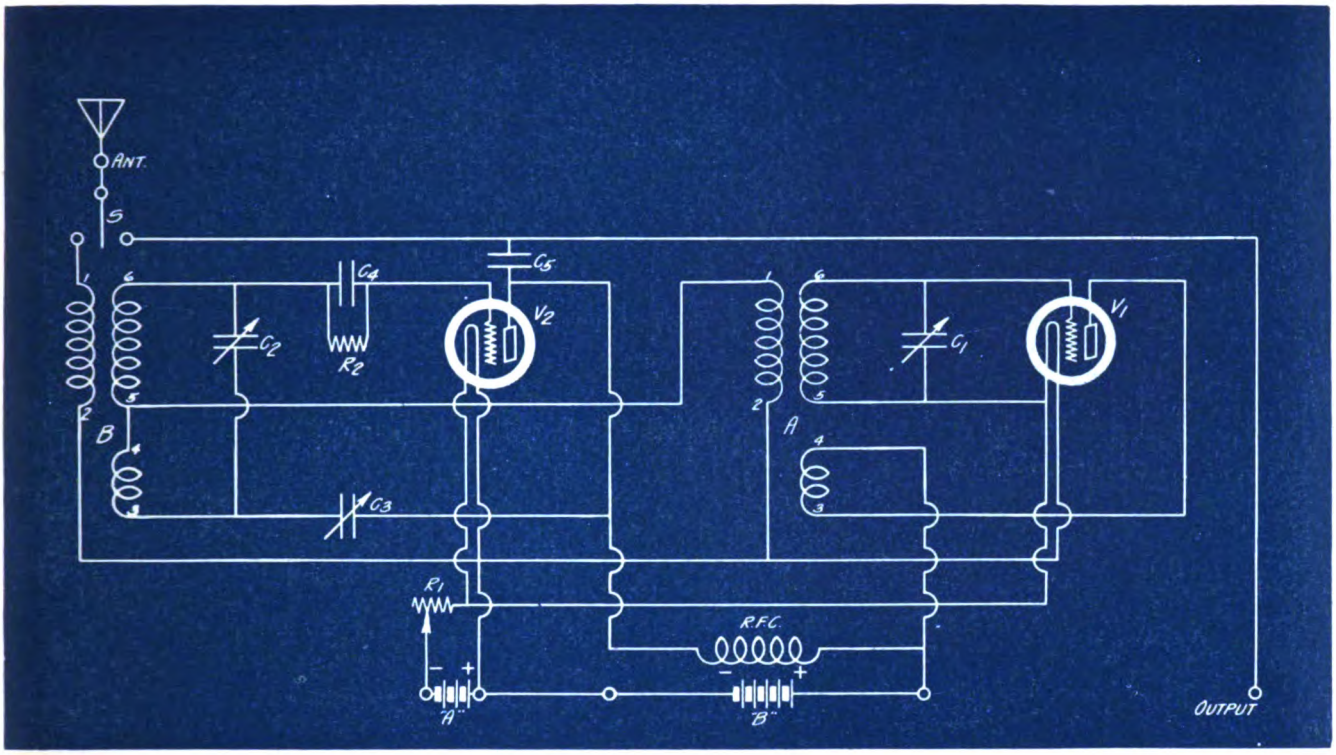
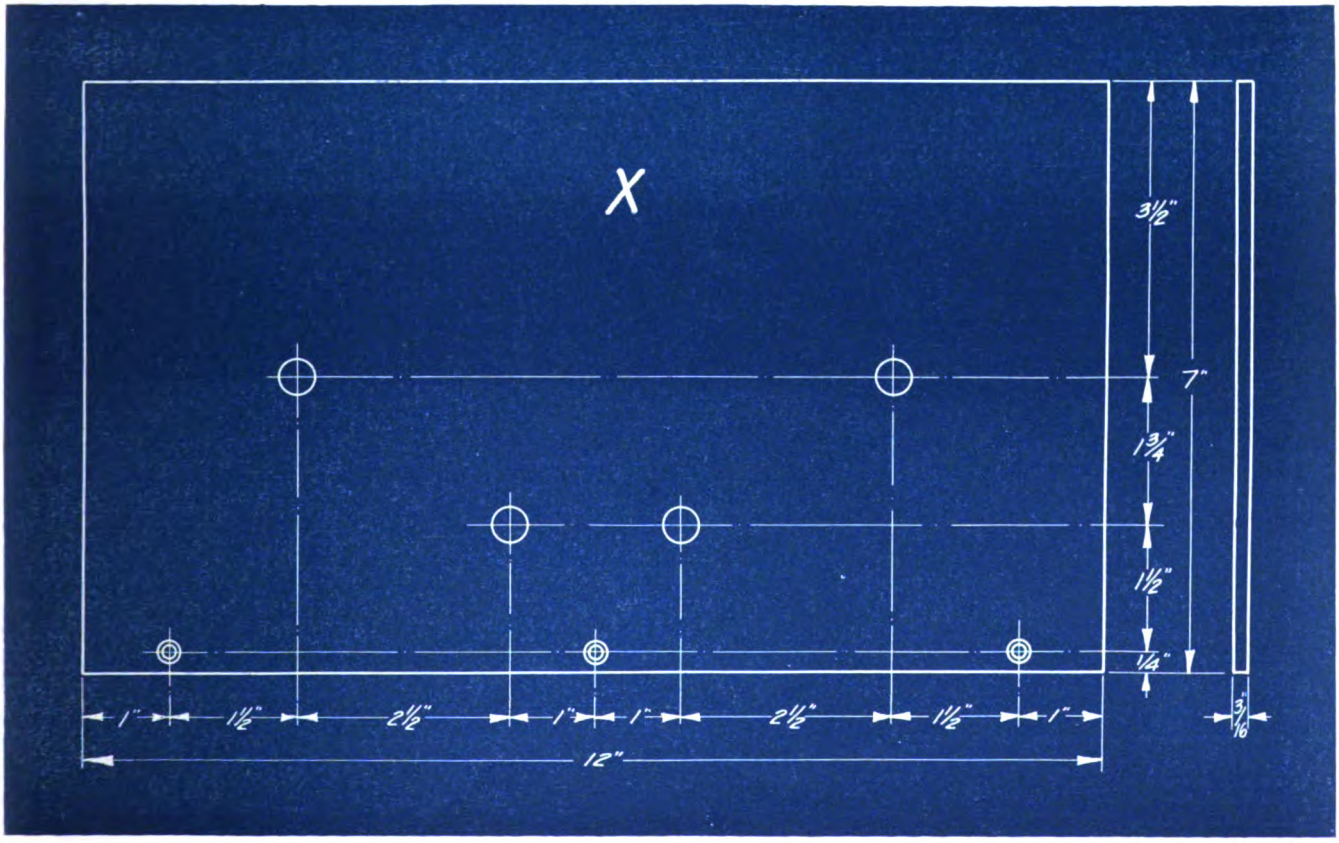


THE COMPLETE HOOK-UP

FIGURE 5: *The valve at the left and its circuit receive and amplify the incoming signal while the right-hand valve is the oscillator which furnishes the high-frequency energy which heterodynes with the incoming signal frequency, resulting in the action described in the text of the article.*



THE EXACT PANEL LAYOUT

FIGURE 6: *The panel should be laid out and drilled exactly as shown here. The diameter of the holes will depend on the size of the shafts and screws used. All the instruments employed are of the single hole mounting type.*

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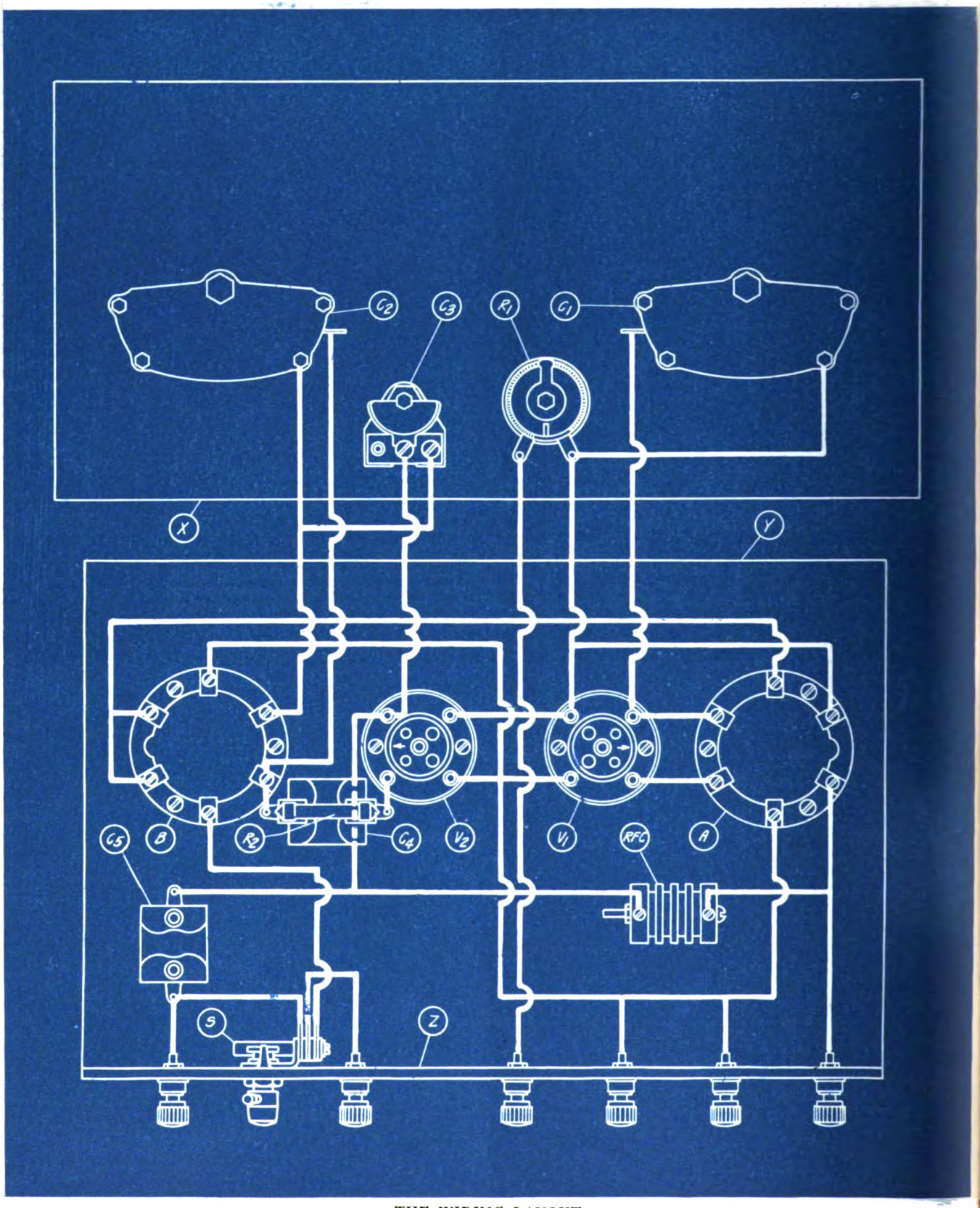

THE WIRING LAYOUT

FIGURE 7: *All instruments are shown here in a slightly altered position, in order to facilitate the illustration of the wiring. The wiring is represented by the heavy white lines. To simplify the wiring, much of it can be completed before the panel is mounted on the baseboard. This plan is described in the text.*

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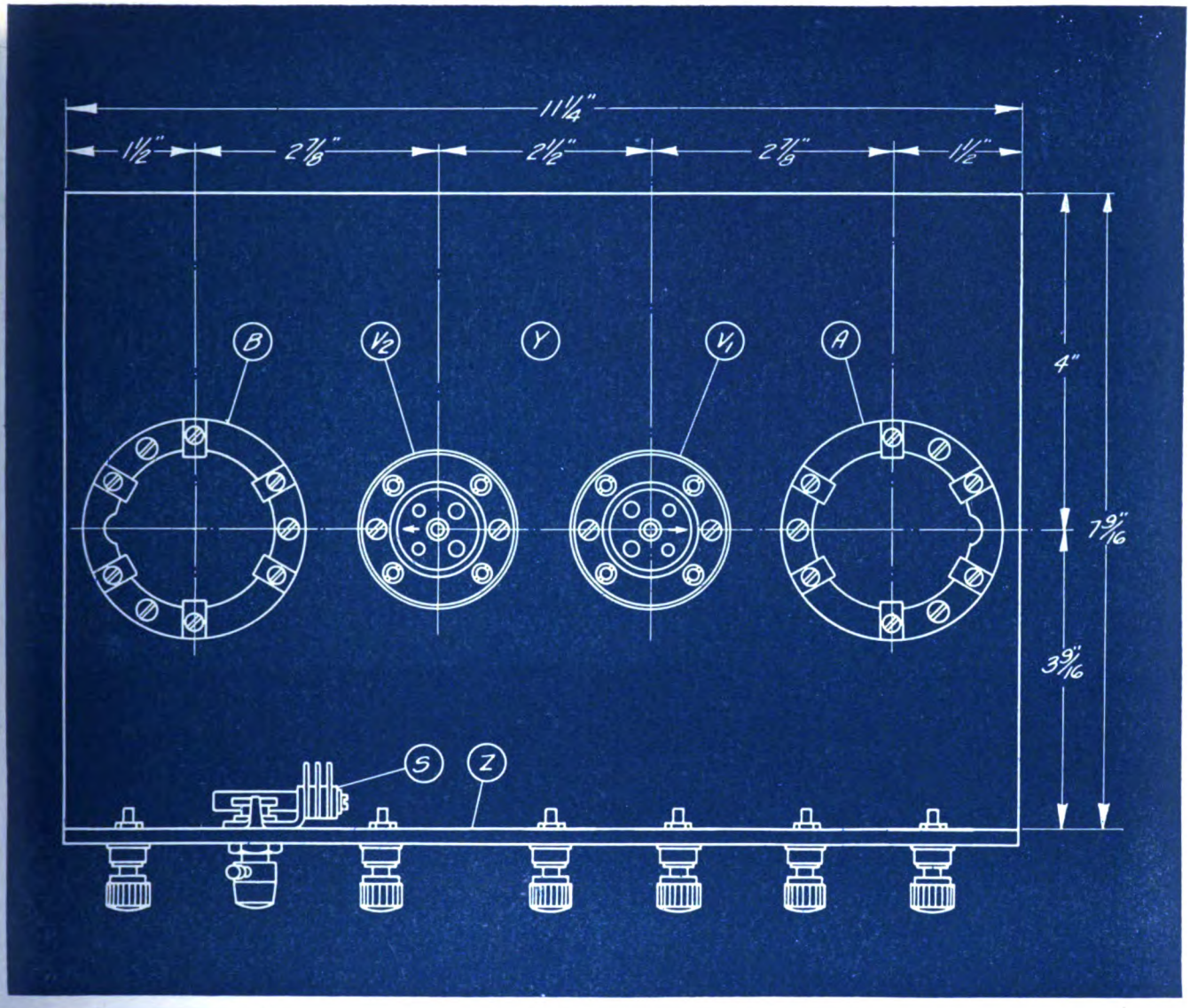
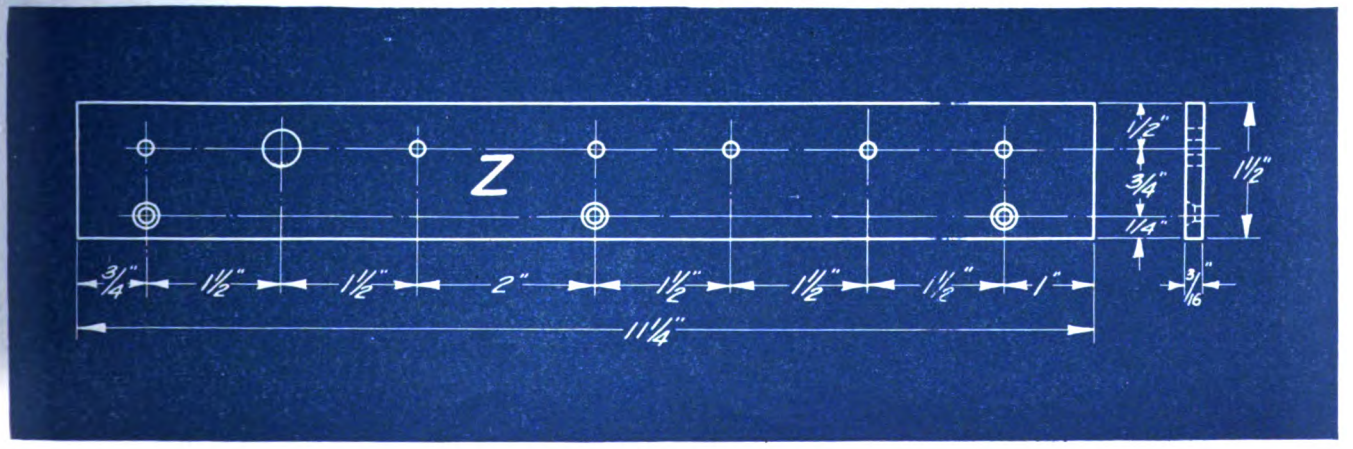


THE BASEBOARD LAYOUT

FIGURE 8: *The baseboard is shown here with all dimensions for its preparation and for the mounting of the instruments. The choke coil and fixed condensers are not shown because they are supported by the wiring and are not mounted on the baseboard. The binding post strip is shown in position.*



THE BINDING POST PANEL

FIGURE 9: *Complete specifications for the preparation of the binding post strip are given here. After the drilling has been completed the binding posts and switch are attached, as shown at the bottom of* FIGURE 3.

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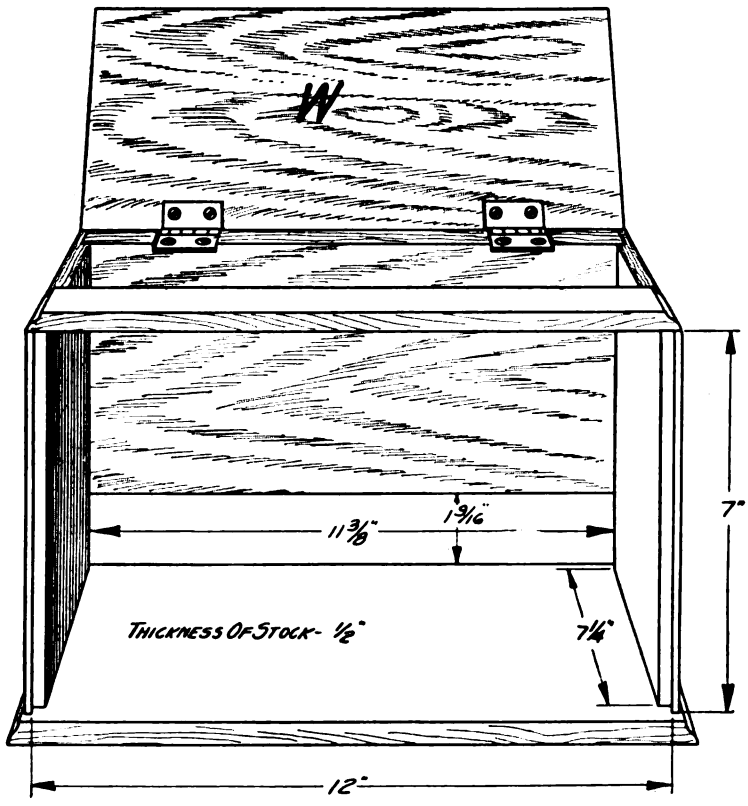


THE CABINET SPECIFICATIONS

FIGURE 10: *The cabinet used with the model of the Pre-selector is a standard stock size. For those who may wish to construct their own cabinets, however, the specifications are given here.*

ferred. The free use of soldering lugs is recommended, especially at the terminals of the coil sockets. It goes without saying that all connections should be securely soldered.

Refer constantly to the diagram in Figure 7 in wiring up the unit. It will also be helpful to remember, in this connection, that all of the connecting wires which run in an end-to-end direction (in reference to the baseboard) should be kept down against the baseboard; these connections should be made first, before the panel is attached to the baseboard. All connections which run in a front-to-rear direction should be kept up about a half inch from the baseboard. This "two plane" method of wiring not only eliminates confusion, but also adds to the appearance of the completed job.

The wiring of the filament circuits should be tackled first. The rear "F" terminals of valve sockets V1 and V2 should be connected and this connector should be extended back to the "A" (+) binding post at the rear of the unit. Next, connect together the front "F" terminals of the two valve sockets and extend this connector on over to terminal 5 of coil socket A. Join together terminals 4 and 5 of coil socket B and extend this connector almost the full length of the baseboard to terminal 1 of coil socket A, as in Figure 7.

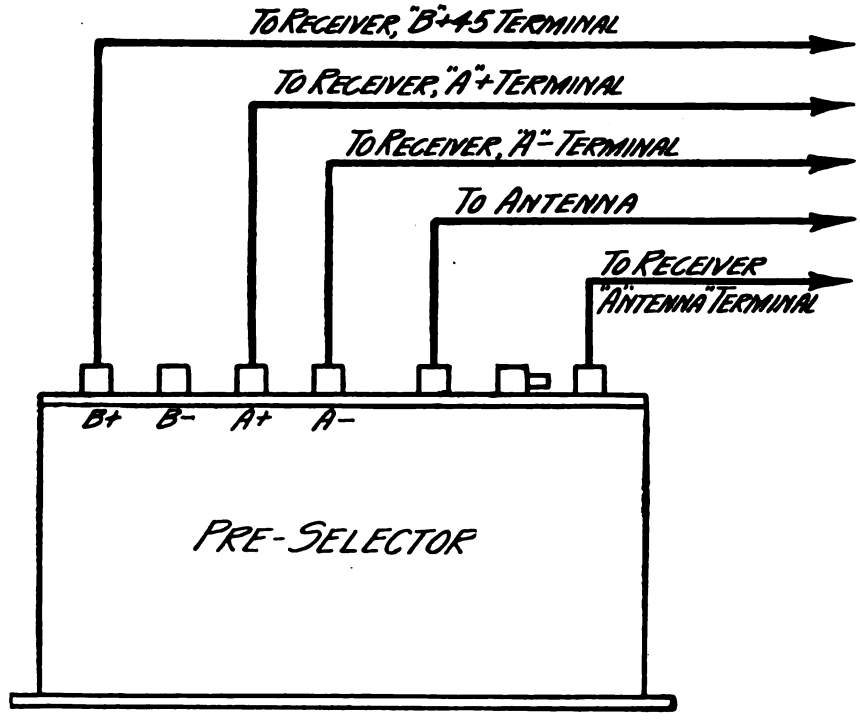
and the binding posts and jack switch S mounted in their proper positions. If engraved binding posts are used they should be mounted in the following order, beginning at the left hand end: B+, B—, A+, A—, Antenna, and an Output Post. The switch should be mounted between the last two posts. The completed binding-post strip is then ready to be permanently mounted on the rear edge of the baseboard.

The two coil sockets and the two vacuum-tube sockets should be mounted on the baseboard by means of two wood screws each. Then, mount the choke coil, RFC, in a horizontal position by means of a right angle brass bracket (or it may rest on the baseboard and be held in position by the connecting wires if desired). Do not, in any case, try to remove the brass bolt that runs through this choke. The positions of all these instruments are given in Figure 8.

This completes the construction work, except that the front panel has not been attached to the baseboard. This may be left off for the time being, as a goodly portion of the wiring can be completed without it.

How to Wire the Pre-selector

In wiring the Pre-selector, the constructor may use either bare or insulated bus wire, but the latter is to be pre-



HOW TO CONNECT UP THE PRE-SELECTOR

FIGURE 11: *The same batteries may be used to operate the Pre-selector that are used with the receiver. The connections for this arrangement are shown above. (Be sure to read the text carefully before connecting the Pre-selector.)*

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Connect terminal "G" of valve socket V1 to terminal 6 of coil socket A, and terminal "P" of this same valve socket to terminal 3 of this same coil socket. Connect terminal 2 of coil socket A to the "A" (+) plus binding post on the rear terminal strip and also to the "B" (—) minus post. Terminal 4 of this coil socket should then be connected to the "B" (+) plus binding post at the rear and another connecting wire run from this same coil socket terminal to the nearest terminal of the choke coil, RFC.

From the other terminal of RFC make a connection to the "P" terminal of valve socket V2. Later, another connection must be made from this last wire to one terminal of the fixed condenser, C5, so it is well, if insulated bus wire is used, to bare a space on this wire before it is actually soldered into place.

The switch, S, should next be wired up. Its top terminal should be connected to the antenna binding post at the rear, and the middle terminal to the extreme right-hand binding post (output) on the binding-post strip at the rear of the unit. Then, connect the bottom terminal to terminal 1 of coil-socket B.

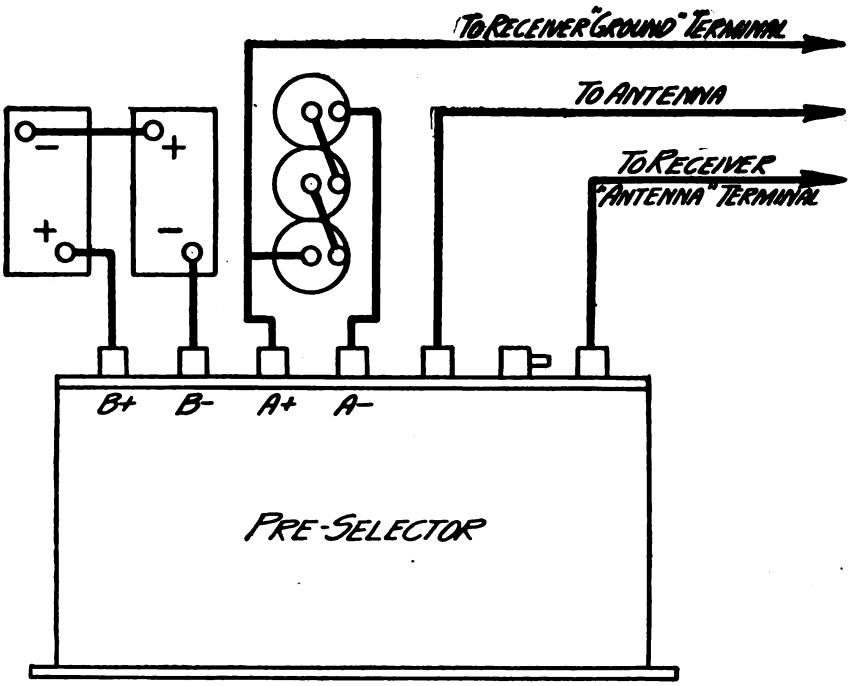
It is now time to connect in the fixed condenser, C5. Solder one of its terminals to the output binding post at the rear, and make a connection from the other terminal to the spot previously bared on the connecting wire which runs from RFC to the "P" terminal of valve socket V2.

Finally, connect the grid condenser, C4, into the circuit, with one of its terminals going to terminal "G" of valve socket V2, and the other to terminal 6 of coil socket B.

One more connection may be made before the panel is mounted. Connect the rotor terminal of the midget condenser, C3, to the rotor terminal of condenser C2. The panel may then be attached to the baseboard.

Now connect the rotor of condenser C2 to terminal 3 of coil socket B; the stator terminal of this same condenser should be connected to terminal 6 of coil socket B. The stator terminal of C3 should next be connected to terminal "P" of the valve socket V2.

The rotor terminal of condenser C1 should be connected to terminal 5 of coil socket A and terminal 6 of this coil socket should be connected to the stator of this condenser. When this has been done, connect the terminal of the rheostat R1 which is nearest to condenser C1 to the front "F" terminal of valve socket V1 and the other terminal of the rheostat to the "A" (—) minus binding post at the rear.



CONNECTIONS FOR THE USE OF SEPARATE BATTERIES

FIGURE 12: *If the receiver is an AC operated device, the use of separate batteries for the Pre-selector will be necessary. The proper connections are shown here. The batteries used in the set-up shown here are described in the text.*

How to Install the Pre-selector

The Pre-selector may be installed at the end of the receiver nearest to the receiver antenna terminal. Disconnect the antenna from the receiver and reconnect it to the antenna binding post of the pre-selector. The "output" binding post of the Pre-selector should then be connected to the "Antenna" binding post of the receiver.

No ground connection is made to the Pre-selector unless the filament circuit of the receiver is ungrounded. This latter condition may be determined by connecting a buzzer or 6-volt lamp to the "ground" binding post of the receiver, and the other side of the buzzer or lamp to first the positive and then the negative terminal of the "A" battery or of the receiver. During this test the receiver should be turned "on." If the lamp lights or the buzzer sounds it is an indication that one side of the filament circuit of the receiver is grounded. If the test shows that the filament circuit is not grounded then it will be necessary to connect the ground terminal of the receiver to the "A" (—) minus terminal of the Pre-selector.

All connections from the receiver to the batteries or power-pack should be left as they are. No changes whatsoever are needed in the receiver connections except in the "antenna" connection as described above. The Pre-selector requires a 45-volt "B" supply and either a 4½-volt or a 6-volt "A" supply. The same "A" supply as is used for the receiver may be used for the Pre-selector. UX-199 type valves are used in the Pre-selector.

It is also practicable to use the receiver "B" supply for the Pre-selector. Connections for this arrangement are shown in Figure 11. It should be noted that no "B" (—) minus connection is made to the Pre-selector. This is because "B" (—) minus is already connected to one side of the "A" battery in the receiver.

In case the receiver uses an AC supply for the filaments (as with McCullough AC valves) it will be necessary to use separate "A" and "B" batteries with the Pre-selector. Connections for this arrangement are shown in Figure 12. The "A" battery should consist of three 1½-volt No. 6 dry-cell batteries, connected in series as shown in the diagram, and two midget-size "B" battery blocks of 22½ volts each. The low current-consumption of this unit makes a larger size of "B" batteries unnecessary. The midget size (2 lb.) will provide several hundred hours' service, and the life of the dry-cell "A" battery mentioned will be in excess of 200 hours.

With the connections made, as shown in Figure 11 or in Figure 12, the unit is ready for operation. When the switch at the rear of the Pre-selector is thrown to the left the Pre-selector is connected into the antenna circuit between the receiver and the antenna. When this switch is thrown to the right, the antenna

(*Continued on page 496*)

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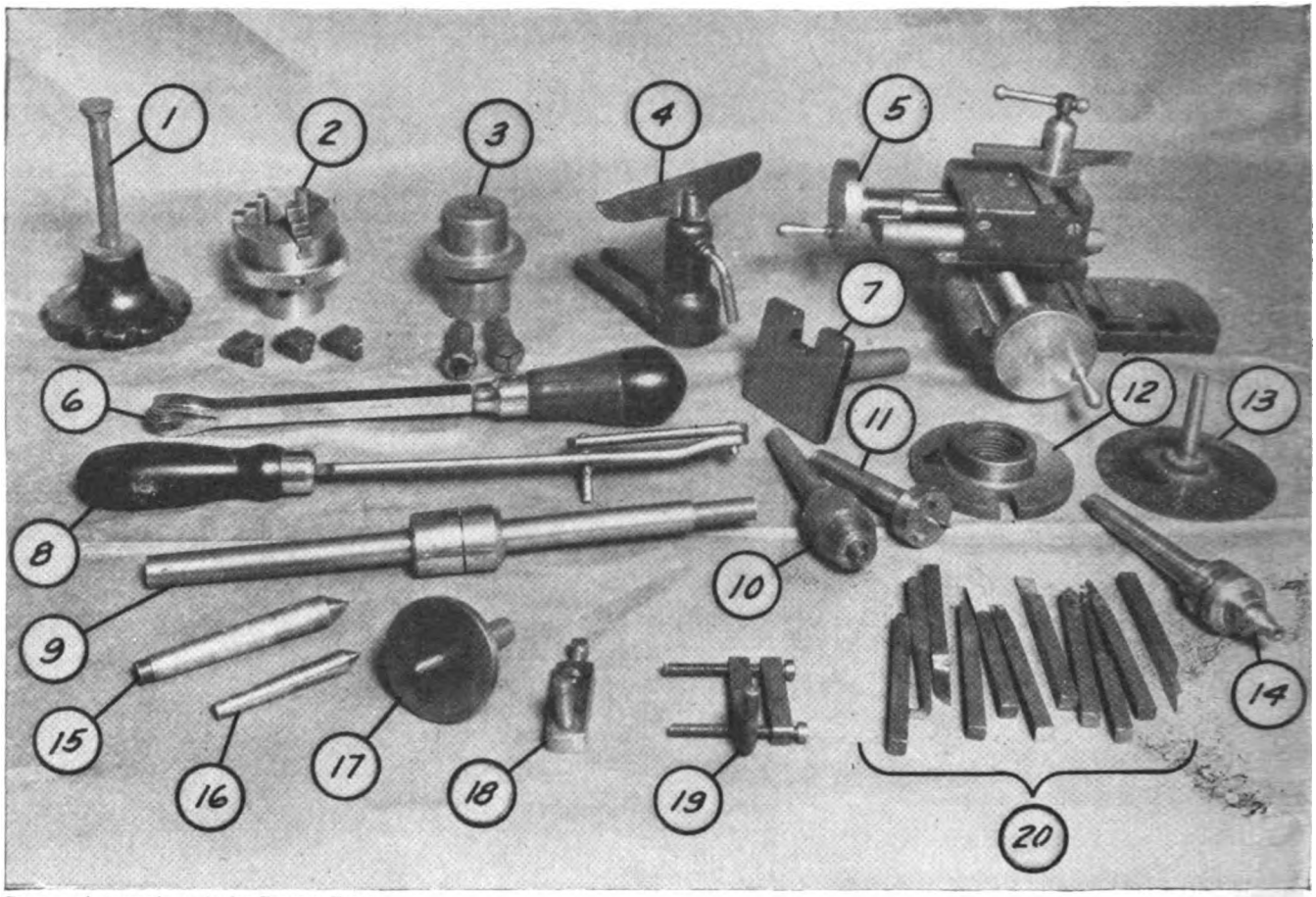

From a photograph made for POPULAR RADIO

THE COMPLETE KIT OF LATHE TOOLS

FIGURE 1: *Here is a complete set of attachments (with the exception of the jig-saw) for the lathe described in the first article of this series in the April issue. With this equipment the experimenter becomes independent of outside shops for his wood and metal finishing. The particular use of each attachment is described in the text.*

Your Laboratory Tools

ARTICLE NO. 2

From this article the home experimenter may learn how to multiply the capacity of his shop in many ways through the use of the simple attachments to his lathe described in this article.

By LOWELL MADDEN, JR.

THE purpose of this installment is to acquaint the reader with the use of the sundry gagjits that are made to increase the range and capacity of the lathe described in the first article of the series.*

A lathe, even more so than mother's sewing machine, is perhaps the most "attached" tool in all of machinedom. Rarely is it used in its naked form and rarely does the operator (providing he knows his mechanical onions) come upon a job that cannot, by some hook or crook, be tossed off neatly and quickly. In some instances he may have to do a little thinking, but he will eventually come upon a method that will solve his immediate problem. After all, the range of work that may be done on a lathe depends to a large extent upon the ingenuity and inventive talent of the operator.

The device marked 1 in the illustration is a clamping nut that holds the slide rest, 5, and the tee rest, 4, in place. This is also pressed into service in holding the jig-saw attachment and the saw table for the circular saw. The bolt of this clamping device comes up through the slot in the center of the lathe bed and it engages with a second slot in the attachments mentioned. The slot of the tee rest, illustrated at 4, is plainly visible.

There is no substitute for a lathe chuck and unless a lathe is equipped with one the operator is confronted with a handicap that is practically impossible to overcome, no matter how clever he may be in arranging makeshifts. A little scroll chuck for use in connection with this lathe is illustrated at 2. This is screwed directly onto the live center of the lathe. The knurled portion of the chuck is turned to move the jaws in or out. An extra set of outside jaws greatly increases the range of the size and form

*See POPULAR RADIO for April, 1927.

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of the pieces that may be held in the chuck.

A chuck of a different type, and one that is extremely useful in turning down and cutting off small metal rods, is illustrated at 3.

This tool is called a compression chuck and it is provided with slotted bushings, two of which are shown immediately in front of it. When the knurled collar of this chuck is turned, the bushing is pinched in such a way that the three slotted portions or jaws are forced together. It will be seen that the range of movement of these jaws is restricted to a small distance; consequently only metal rods approximating the diameter of the hole in the bushing can be held tightly enough for turning. As there is a hole through the center of this chuck which is in line with the hole in the center of the live spindle, long pieces of rod may be fed through the spindle of the lathe. This will be found particularly convenient when the operator has a large number of pieces of rod that have to be cut off.

A tee rest is an attachment used especially for the turning of wood and light metal by the use of hand tools. It derives its name from the fact that it is shaped like a T and that it offers support for the cutting tool while it is being manipulated. Such a device may be identified at 4. The height of the rest is made adjustable by the use of a small set screw.

Unless a lathe is provided with a slide rest, the operator will at all times have to resort to the use of hand turning tools. In the case of turning wood, hand turning tools are, of course, preferable, but only the crudest sort of work can be accomplished by the use of such tools in turning metal. After all, very little control can be exercised over hand tools and real accurate turning by their use is practically impossible. The slide rest made especially for the lathe under discussion is illustrated at 5.

An examination of this attachment will reveal two sliding portions, each one controlled by feed screws. The feed screw shown at the lower right drives the cutting tool in a direction parallel to the work revolving between the lathe centers, while the manipulation of the feed screw at the left drives the cutting tool in a direction at right angles to the work in the lathe. Tools of different character intended for special cutting jobs may be placed in the tool post which is shown mounted on the top of the slide rest. A later installment will give more detailed information concerning the manipulation of this very important attachment.

Since knurled edges are used on binding posts and adjusting screws and nuts, the radio enthusiast will want to have his lathe equipped with the necessary means for producing knurled surfaces. This work is accomplished in a surprisingly simple manner. A little tool with a roller mounted in the end of it is all that is necessary. The roller is of hardened steel and it carries on its surface the impressions that are to be duplicated to the work revolving in the lathe. A knurling tool is shown at 6.

In the handle of this particular tool there is a set of rollers which produce different knurled effects. These rollers are interchangeable.

In 7 is illustrated what is known as a "table rest." This fits into the same holder as the tee rest. Such an attachment is very useful for grinding down or squaring off surfaces when an abrasive wheel is revolving in the live spindle.

When this particular lathe is used for drilling, it becomes necessary to move the tail stock spindle forward. While this may not be done with a feed screw placed on the end of the live spindle, a more rapid feeding of the work may be had by the use of a handle or lever. Such a lever is illustrated at 8 and its position on the lathe was shown in one of the photographs of the first installment. Its real name is a hand feed lever.

In using a circular saw and saw table in connection with this lathe, the operator has at his disposal a most important wood working tool. With it he may cut bakelite and rubber panels with ease and with every assurance of their being absolutely square, for the saw table is equipped with guides which makes straight sawing a matter slight of accomplishment. By the use of special saws, metal may also be cut with this attachment. The saws for this use, whether for metal or wood cutting, are mounted on the arbor 9.

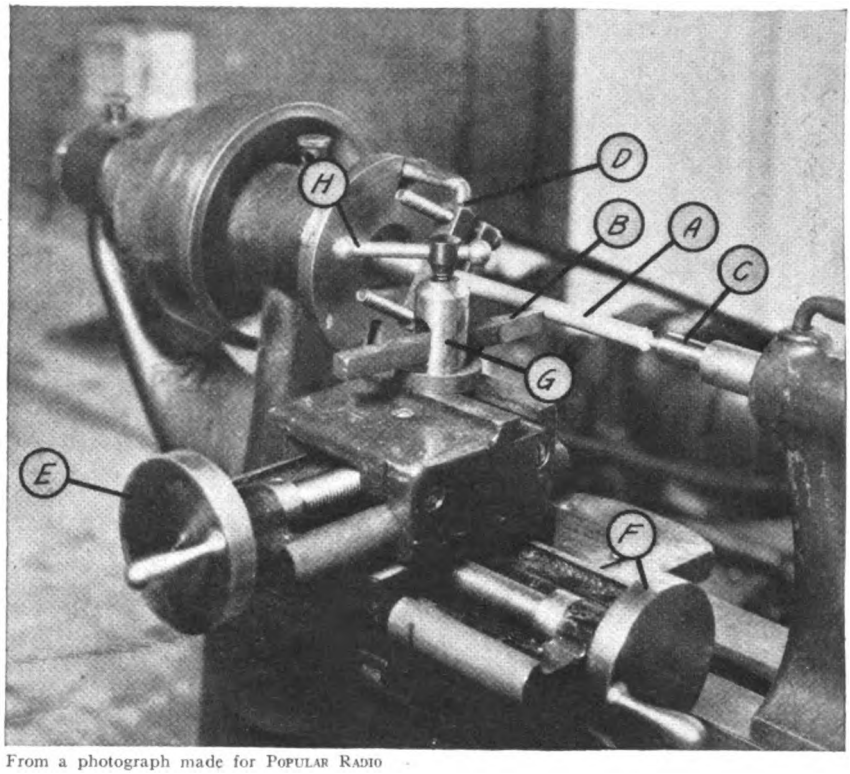
This arbor is turned down at one end so that the lathe dog at 18 will fit it; the dog in turn engages with one of the slots in the slotted face plate at 12.

This face plate is, of course, mounted on the live spindle of the lathe.

The saw arbor revolves upon the lathe centers 15 and 16.

The reader may expect more details covering the operation of this circular saw installment in a later installment of this series; what the writer is attempting to do here is to give the reader merely an outline of the use of the various attachments so that he will not get into trouble in attempting to do things that he should not do.

At 10 the reader will find an illustration of a drill chuck. This is provided with a standard No. 1 Morse taper which is the taper used in the live spindle of the lathe. Thus the chuck is held in position merely by forcing it into the taper of the live spindle with a twisting motion. The chuck accommodates drills ranging



From a photograph made for POPULAR RADIO

THE LATHE AT WORK

FIGURE 2: *This shows how the slide rest, slotted face plate and dog are used. D is the dog, C the dead center, A the work to be turned, H the handle of binding post of the tool post G, and E and F are feed screws for the slide rest. B is the cutting tool.*

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in size from sixty to one-quarter inch.

As it is not customary (and indeed it is often impossible) to use a scroll chuck in turning wood, some other means must be employed to grip the work so that power may be transmitted to it from the live spindle of the lathe. The tool used for this is illustrated at 11 and is called a "spur center."

This spur center is provided with an extremely sharp center and three sharp spurs mounted at the points of an equilateral triangle. The spur center also carries a No. 1 Morse taper, so that it may be inserted and held in the live spindle. When this tool is used, the wood to be turned is forced against it until the sharp spurs sink into it and are completely lost to view. The opposite end of the work to be turned revolves on the dead center of the lathe—always, of course, with the aid of a drop of oil.

The face plate for this lathe carries two slots and is shown at 12. These slots may be used in holding pieces of metal to the plate for various turning jobs. The plate screws onto the live spindle of the lathe.

When drilling is being done with this lathe, it will be necessary to use the attachment illustrated in 14. This is called a "drilling pad," and it fits into the dead center or tail stock spindle. Here a No. 0 Morse taper is used which is the taper provided for in the tail stock spindle. In drilling, the work is rested against this pad and is carried forward to the drill by the manipulation of the feed lever illustrated at 8.

It is an easy matter to mount an abrasive wheel in this lathe by the use of the attachment 14. This is called a "grinding wheel arbor," and as it is provided with a No. 1 Morse taper, it may be inserted in the live spindle of the lathe in a jiffy. A clamping nut presses the grinding wheel tightly against a shoulder, thereby preventing it from slipping while work is being done. Naturally the bushing in the grinding wheel must correspond to the diameter of the arbor. This particular attachment may also be used for holding, polishing or buffing wheels.

A lathe without centers is really no lathe at all, for in every case of turning either wood or metal the operator must revolve his work between centers. One center, the live center, revolves with the work, holding it at the same time in a central position while the dead center (on the tail stock) remains stationary. Lathe centers should be ground accurately and they should be made of especially hard steel. When the centers of the lathes are inaccurate the accuracy of the whole tool also suffers. This is by way of a warning to the amateur operator. If he wants to preserve the accuracy of his lathe he should by all means take good care of the centers and see to it that they do not become battered or rusted.

The two centers used with this particular lathe are illustrated in 15 and 16. The large center, which is used in the live spindle, is a No. 1 Morse taper shown in 15, while the dead center is a No. 0 Morse taper, which is illustrated in 16.

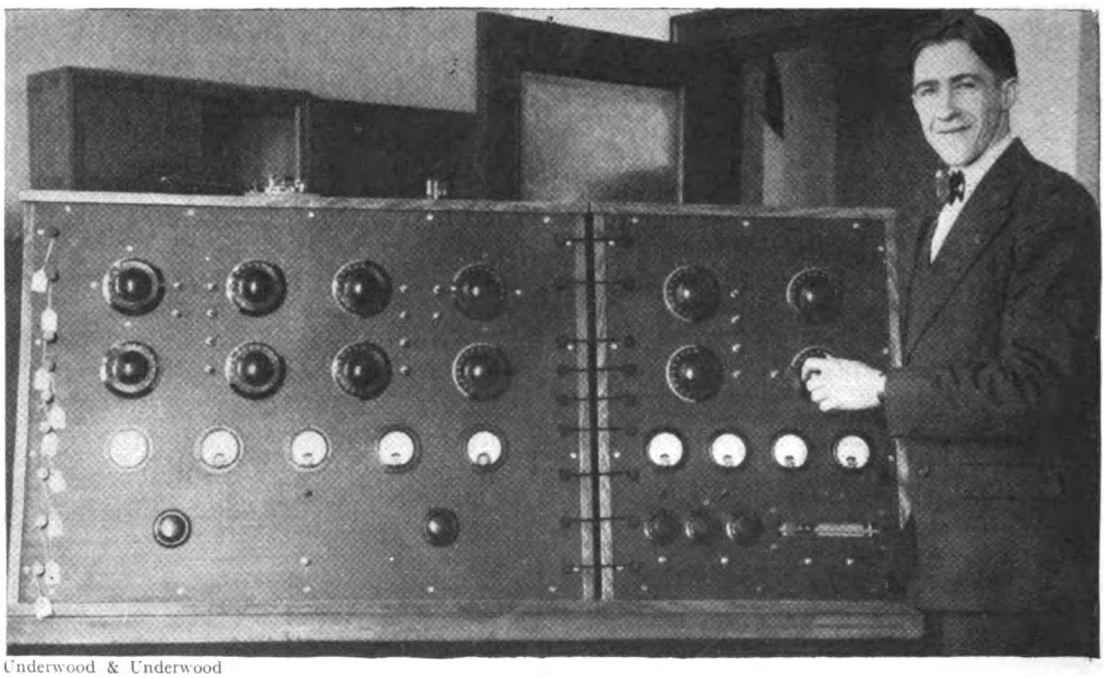
In turning flat pieces of wood, it is necessary to employ a screw center. Such a center will be found at 17. It, too, is provided with a No. 1 Morse taper, so that it may be forced into the live spindle. An ordinary wood screw is mounted in the center of this device and the wood to be turned is held in such a manner.

Two different types of lathe dogs are presented in 18 and 19.

It is the work of these dogs to transmit power to metal revolving between the lathe centers. Their use is a little too complicated to be described in this installment; consequently the writer is withholding this informaation until the next installment of the series when the description will be given over to the subject of metal turning between centers.

Included in the bracket at 20 is a group of lathe tools for use in the slide tool rest which was previously described. Special cutting jobs require special tools, and a set of 12 tools with cutting edges of different shapes and sizes are really necessary. For instance, it would be a poor mechanic who would attempt to cut off a piece of metal rod with a finishing tool or to cut a thread with a cutting-off tool. One of the most important things in learning how to operate a lathe is to know when and how to use the different cutting tools.

Every tool will be treated separately as this series of articles progresses.



Underwood & Underwood

THE INSTRUMENT THAT WILL STANDARDIZE WAVELENGTH MEASUREMENTS

This harmonic amplifier, just completed by the Bureau of Standards Radio Laboratory, has been designed to set the standard to which the wavelengths of all radio stations in the country may be adjusted. With this instrument to regulate wavelengths and the Radio Commission to adjust broadcasting congestion, the ether should soon be relieved of congestion.

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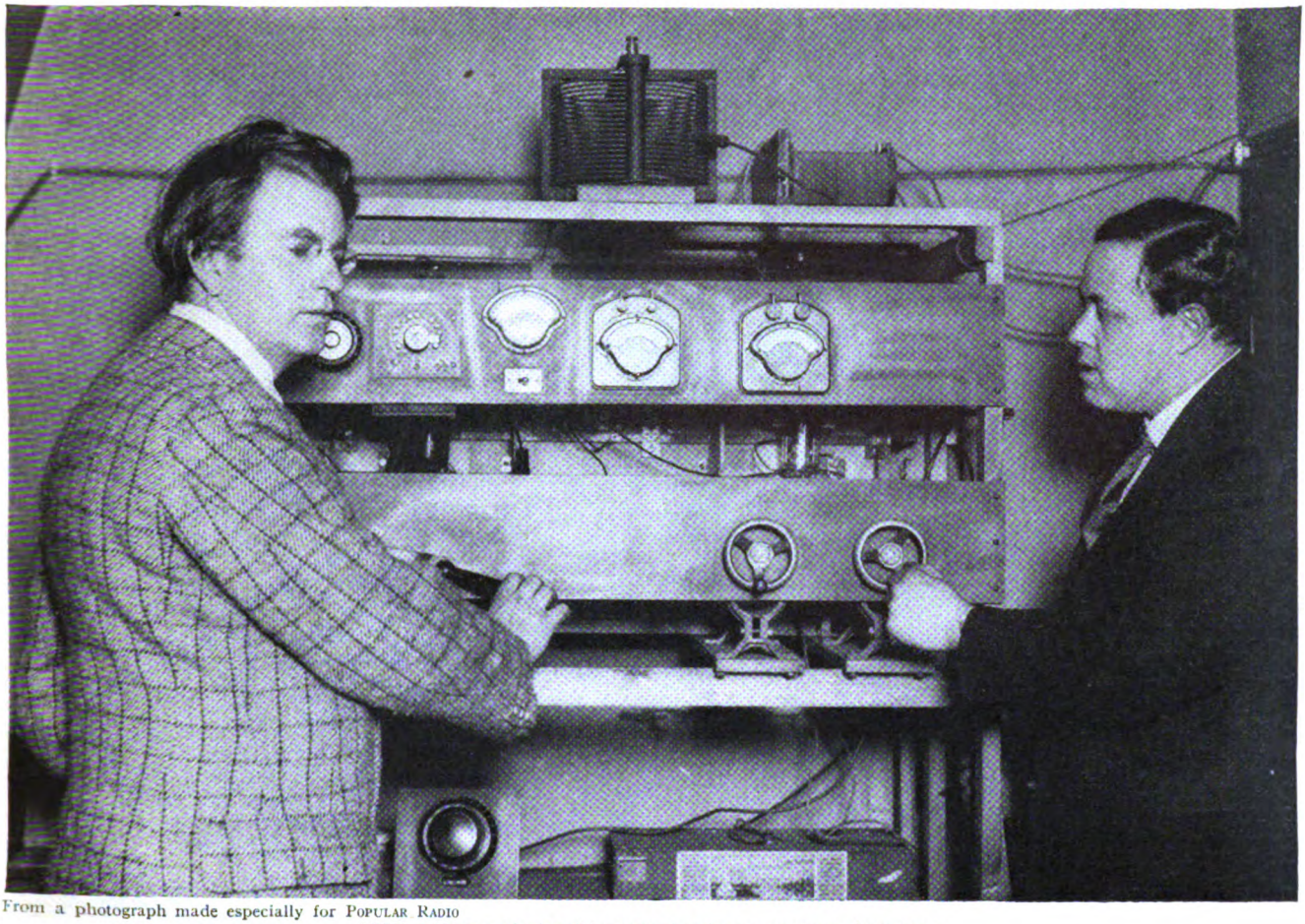

From a photograph made especially for POPULAR RADIO

THE WORLD'S FIRST "TELEVISION BROADCASTER"

From this transmitter, at Station 2TV, in London, Mr. Baird (at the reader's left) made the first trials of broadcasting pictures and real scenes, all of which could be picked up by anyone who has the proper receiving apparatus. When television has been perfected and cheapened (as it is sure to be soon, either by Mr. Baird himself or by some other of the many experimenters now at work), this apparatus may have the same historic interest that the first broadcasting transmitters have to-day.

THE LATEST EXPERIMENTS WITH

Television and "Black Light"

¶ Human faces have been translated into sound and that sound has been sent by radio and recorded on phonograph records.

¶ Individuals have been "seen" by television in an absolutely dark room in which the unaided human eye sees nothing.

¶ These are among the recent accomplishments of the English experimenter, Mr. John L. Baird. In this exclusive article Mr. Baird describes, for the first time over his own signature, the details of the recent experiments which have attracted international attention to his work.

By JOHN L. BAIRD

TELEVISION may be described briefly as the transmission of the images of actual scenes by radio or telegraphy with such rapidity that they appear instantaneously to the eye of the observer at the receiving end.

Fortunately for the success of television, the eye has a time lag; the images, therefore, need not actually be transmitted instantaneously. In fact, if they are transmitted at the rate of eight per second the transmission appears to the eye to be instantaneous.

In television, then, we have to transmit at least eight images per second.

These images, it should be clearly understood, are *not* photographs, but images of the actual living scene.

The transmission of eight photographs per second would not give television, but would be the transmission of a cinemato-

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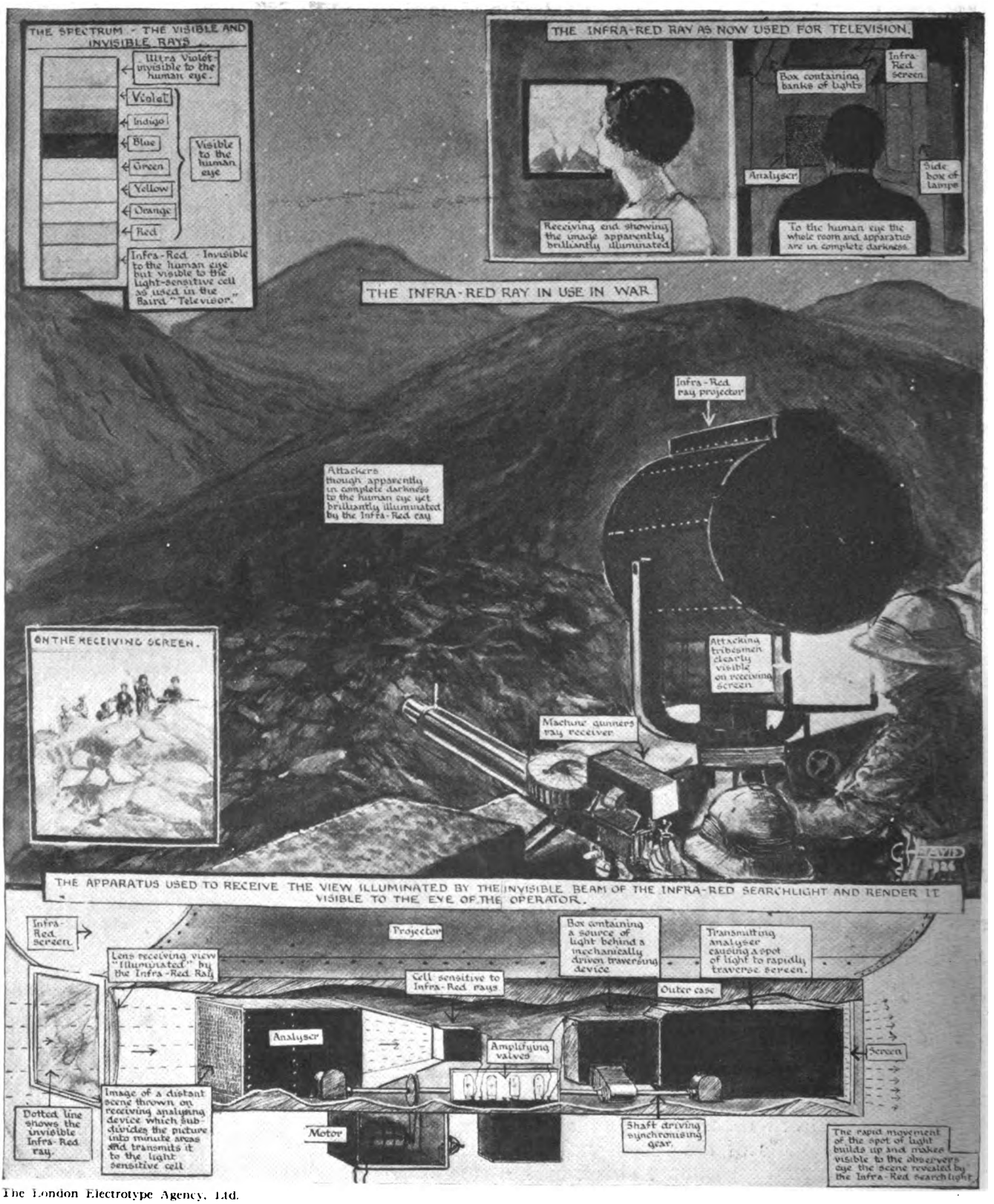
THE SPECTRUM - THE VISIBLE AND INVISIBLE RAYS
Ultra Violet - invisible to the human eye.
Violet
Indigo
Blue
Green
Yellow
Orange
Red
Visible to the human eye
Infra-Red - Invisible to the human eye but visible to the light-sensitive cell as used in the Baird "Televisor."
THE INFRA-RED RAY AS NOW USED FOR TELEVISION.
Box containing banks of lights
Infra-Red screen
Analyser
Side box of lamps
Receiving end showing the image apparently brilliantly illuminated
To the human eye the whole room and apparatus are in complete darkness.
THE INFRA-RED RAY IN USE IN WAR
Infra-Red ray projector
Attackers though apparently in complete darkness to the human eye yet brilliantly illuminated by the Infra-Red ray
ON THE RECEIVING SCREEN.
Attacking tribesmen clearly visible on receiving screen
Machine gunners ray receiver
THE APPARATUS USED TO RECEIVE THE VIEW ILLUMINATED BY THE INVISIBLE BEAM OF THE INFRA-RED SEARCHLIGHT AND RENDER IT VISIBLE TO THE EYE OF THE OPERATOR.
Infra-Red screen
Projector
Box containing a source of light behind a mechanically driven traversing device
Transmitting analyser causing a spot of light to rapidly traverse screen.
Lens receiving view "illuminated" by the Infra-Red Ray
Cell sensitive to Infra-Red rays
Outer case
Analyser
Amplifying valves
Screen
Dotted line shows the invisible Infra-Red ray.
Image of a distant scene thrown on receiving analysing device which subdivides the picture into minute areas and transmits it to the light sensitive cell
Motor
Shaft driving synchronising gear.
The rapid movement of the spot of light builds up and makes visible to the observers eye the scene revealed by the Infra-Red searchlight.

The London Electrotype Agency, Ltd.

An Artist's Conception of How the "Black Light" Televisor Might Be Used in War

Mr. Baird's apparatus may be operated by the invisible infra-red rays, often called "black light," just as it can by the rays of visible light. In this drawing, Mr. G. H. Davis, of London, imagines a force, attacking in complete darkness, detected by the defenders, powerful beams of infra-red rays being reflected back into the Baird televisor. Critics may object that no way is known, at present, to produce beams of infra-red rays having the enormous intensity necessary for this feat, but it is conceivable that new infra-red searchlights can be perfected if they become necessary. At the bottom of the drawing is an outline of the Baird apparatus. In the upper left-hand corner is the complete spectrum of light rays, showing the place of the infra-red rays, in the invisible region just below the red

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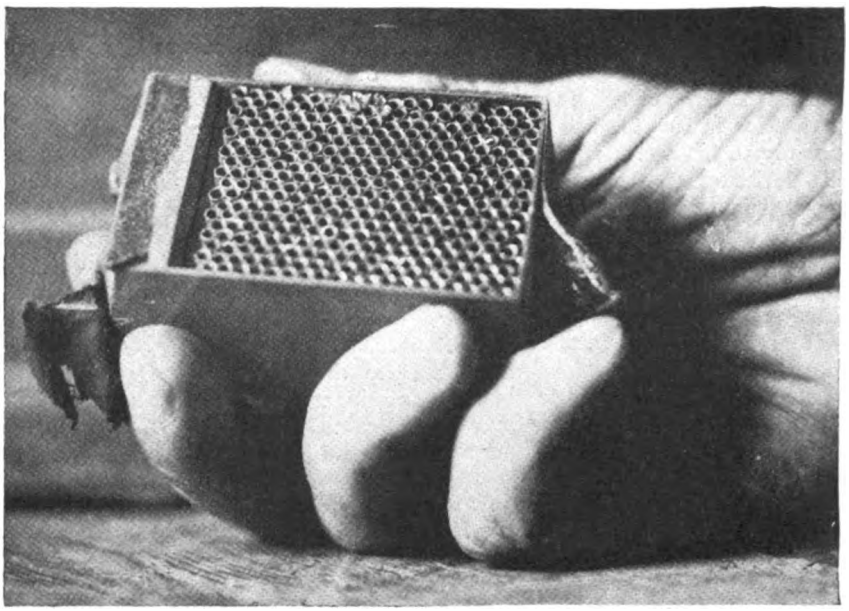
graph film, or "telekinematography."

Nor is the transmission of a single photograph, in any space of time, television. That is another science altogether, "known as phototelegraphy."

The problem of television has been approached by two different methods. The first, and most obvious, was to build an apparatus in imitation of the human optical system.

The human eye consists essentially of a lens which casts upon the retina an image of the object viewed. The surface of the retina consists of several millions of hexagonal cells into which come nerve endings from the optic nerve. These nerve endings are believed to be immersed in a light-sensitive substance known as "visual purple." This substance is ionized by light, changing its color from purple to a grayish yellow.

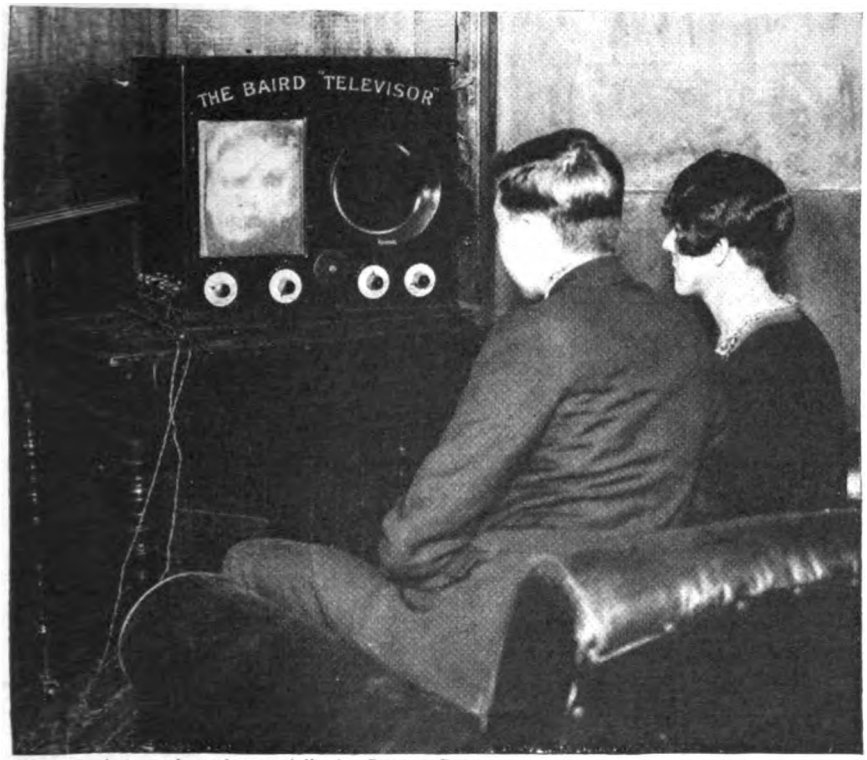
Present-day theories of vision assume that the ionization of the visual purple sends impulses along the nerve fibres to the visual centers of the brain. In life, the visual purple is continually renewed so that, in effect, the eye might be compared to a cinematograph camera—with the difference that in place of using a moving film, coated with a light-sensitive emulsion, the light-sensitive emulsion itself is continually changed.



From a photograph made especially for POPULAR RADIO

THE CELLULAR STRUCTURE OF THE PROJECTOR

By this series of metal tubes, reminding one of the many-lensed structure of the eye of an insect, the scene to be transmitted is split up into a large number of small units, one unit being seen through each of the small tubes. The slotted disks of the transmitter revolve behind this cellular structure, so that the units of scene corresponding to the individual tubes are exposed in succession and allowed to pass into the photoelectric cell, to be sent out in the same succession over the radio wave to a synchronized receiver.



From a photograph made especially for POPULAR RADIO

SEEING AND HEARING BY RADIO

In this latest experimental model of the Baird television receiver, a loudspeaker is incorporated in the same cabinet, so that speech and sight can be received simultaneously. The receiving apparatus inside the case reproduces, in regular order, the signals corresponding to the scene units sent by the transmitter. The action is so rapid that these individual units of light or shade blend to make a complete reproduction of the original scene. The limited number of units into which the scene is divided means, however, that some detail is lost.

In the human television system the scene viewed is transmitted to the brain as a mosaic consisting of an enormous number of little areas, each of which is transmitted at the same time to the receiving centers of the brain.

Artificial vision models on these lines were actually made by several early television workers. In 1906 Rignoux and Fournier constructed an apparatus the transmitter of which consisted of a wall covered with 64 large selenium cells; each of these cells was connected to a corresponding shutter at the receiving station, so that when light fell on any cell its corresponding shutter opened at the receiving station and a spot of light appeared on the receiving screen.

By covering the transmitting wall with large stencils, shadowgraphs of letters and geometrical figures were transmitted. The stupendous number of cells, wires and shutters required, however, made the practical development of such a scheme out of the question.

The second line of attack was to use one cell only and cause each of the elemental areas to fall in succession upon this one cell, the varying current from the cell to be transmitted to the receiver and there control the intensity of a point of light traversing a screen in synchronism with the traversal of the image over the cell. This point of light was

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to be bright at the high lights and dim at the shadows, and was to make eight complete traversals of the screen per second, so that persistence of vision would cause the whole image to appear instantaneously to the eye.

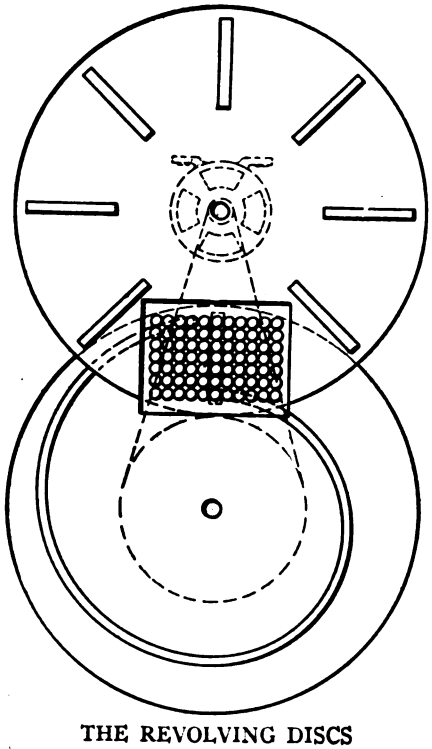
To devise optical apparatus capable of causing an image to traverse a cell proved to be a comparatively simple matter and a considerable number of similar devices were invented at an early date.

Had this been the only problem, television would have been achieved forty years ago.

But the real problem was to obtain a light-sensitive device capable of giving an adequate response at the immense speed of signalling necessary. The early workers had only the selenium cell to work with, and this was found to be far too sluggish. Later, when the photo-electric cell was discovered, it was eagerly seized upon by television workers, but although the response of the photo-electric cell is instantaneous, its output is so minute as to be insufficient for the purpose.

The modern development of thermionic tube amplifiers altered the whole aspect of the problem by giving a means of amplifying the most minute currents to almost any extent, and an attempt was made to use tube amplifiers in conjunction with the photoelectric cell.

Again, however, disappointment was in store. Even the stupendous amplification now obtainable was insufficient.



THE REVOLVING DISCS

At the two discs revolve behind the cellular structure of the projector, the combination of the spiral slot of one disc with the radial slots of the other disc exposes the unit tubes of the cellular structure, individually and in succession, thus creating the signals to be sent.

Using a potassium cell, to obtain an adequate reponse would require, I estimate, an amplification at least one thousand times greater than that obtainable with the present thermionic tube.

When the number of stages of amplification is increased beyond a certain point, the intrusion of parasitic noises due to battery irregularities and other causes sets a practical limit to the amplification obtainable. By using great care this limit can be extended, but even then a further limit is reached when noise due to the irregular electron emission of the tube filament makes its appearance.

The tube, however, in conjunction with the potassium photoelectric cell, while it did not produce television, enabled shadows to be transmitted, for with shadows the light problem does not arise. The cell has only to distinguish between complete darkness and a light which may be almost as intense as we like to make it.

In television, however, only the light reflected back from the elemental areas of the image is available, and this light is infinitesimally small.

The first problem, then, was to produce a device capable of giving an adequate reaction to this very minute stimulus.

Four years ago, when I decided to devote my entire time to an effort to achieve television, the problem seemed comparatively simple. Two optical exploring devices working in synchronism, a light-sensitive cell and a controlled varying light source capable of rapid variation were all that were required, and these appeared to be, to use a patent-office term, already "known to the art."

The problem of synchronism had, apparently, already been solved in multiplex telegraphy. A number of optical exploring devices were already known. The photoelectric cell in conjunction with the thermionic tube appeared to offer a ready-made light-sensitive device, and the glow discharge lamp an ideal light source.

The only ominous cloud upon the horizon was the fact that in spite of the apparent simplicity of the task, no one had produced a demonstrable system of television.

The trouble lay in the cell.

After six months of work, however, I managed to get shadows through. The step from shadows to images by reflected light proved extremely difficult, but in April, 1925, I had the satisfaction of transmitting simple outlines by reflected light.

The outlines transmitted with this first machine were crude and flickering, and were simply outlines; no gradations of shading and no details were visible. The mechanical details of the transmitting and receiving apparatus used in these early experiments have already been described in these pages.*

The next step—to produce a real image with light gradations and detail—was a good deal more difficult than I anticipated. The image persisted in coming through simply in black and white.

After six months of effort, however, the remaining difficulties were overcome, and I had the satisfaction at last of seeing on the receiving screen a real image with gradations of shading and detail.

An open invitation was extended to members of the Royal Institution and on January 27th, 1926, forty members witnessed what was, I believe, the first demonstration of true television ever given.

In describing the results I cannot do better than quote from the report published in the *Electrician* on June 25th, 1926:

> "A young lad, one of the office staff, first took his place in front of the transmitter, and was clearly recognizable, not as a silhouette, but with half-tones and detail, in appearance similar to the early cinematographs."

The images obtained during the first demonstrations of real television were flickering and imperfect, and their improvement is one of the problems in which I am now engaged.

Three methods of casting an image are known. A lens, a mirror or a pin-hole may be used. I have, however, devised another method by means of which an image may be projected; this method, which has been used by me in some recent experimental work, may prove of interest to readers of POPULAR RADIO.

A cellular structure is built up of a bank of tubes of very small bore. A view of the arrangement is shown on preceding page.

Each of the tubes conveys a small elemental area of illumination, so that we now have the image split up into scores of tiny round sections or dots; it only remains to impress the light values represented by each individual dot on to the light-sensitive cell in its proper sequence.

This can be done by means of two discs revolving between the tube block and the cell. For this purpose I have retained two of the discs of my original machine. One of these discs has a long spiral slot in it, whilst the other has a series of radial slots. These are mounted immediately behind the block of tubes, in such a manner that the discs overlap, the overlapping portions moving past each other in opposite directions as the discs revolve. The diagram on this page shows the arrangement.

*See POPULAR RADIO for November, 1926.

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The spirally slotted disc, revolving comparatively slowly, exposes layer after layer of tubes to the light-sensitive cell, shifting its opening across the block in a vertical direction. The slots in the other disc, which revolves at a high rate of speed, are so arranged, however, that the light ray of only one tube at a time is exposed to the light-sensitive cell.

Thus, while the lower layer of tubes is open to the cell through the spiral slot, the slots in disc swing rapidly along the line and flash the light of each tube in turn onto the cell. Then the next row of tubes is dealt with, and so on, until the entire image has been flashed over the cell.

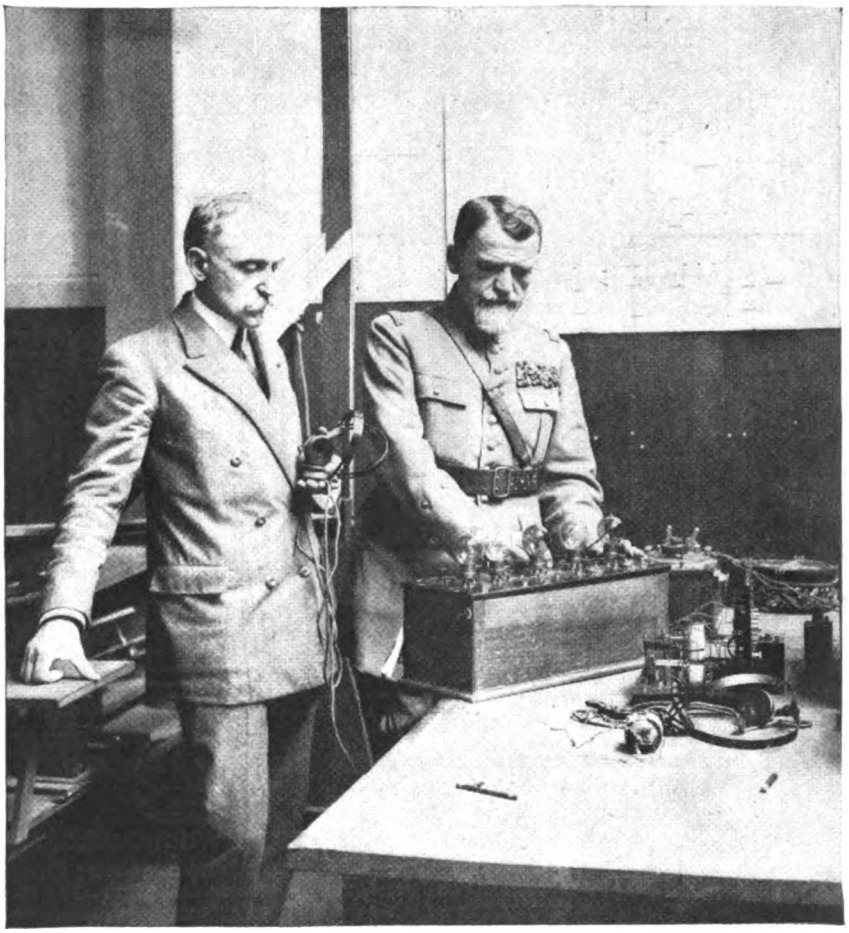
At the receiving end exactly similar apparatus is installed, only the light-sensitive cell is replaced by a source of light which is varied by the incoming electrical impulses, which are strong for high lights, medium for half tones, and zero for dark parts of the picture.

Immediately in front of the block of projecting tubes, at the end remote from the spinning discs, there is a ground glass screen upon which the picture appears, a reproduction of the original, complete with even gradations of light and shade, and showing the movements of the sitter as would a movie film.

A peculiarity of a cellular structure is that the image it projects has no focal depth; that is to say, if the structure is held up so that an electric light bulb can be seen through it, the image of the bulb will remain exactly the same size, whether the structure is held close to the light or several feet away from it. The only noticeable difference is that the further away it is held the more blurred the image becomes.

Whereas my original machine, employing a combination of shutters and lens discs to project the image onto the light-sensitive cell, tended to produce at the receiver a picture made up of closely-fitting narrow strips, the new method gives a picture made up of tiny dots, like a newspaper reproduction. The grain can be made finer by this method, and the picture can be reproduced on a larger screen, but even so the ultimate degree of fineness obtainable, when enlarging the screen, is necessarily limited by mechanical imperfections. Obviously there is a limit to the number and thinness of the projection tubes which can be employed, as also there is a limit to the speed at which the discs can be revolved.

My next step, therefore, was to find an exploring method free from these limitations, and I have now succeeded in doing this. Unfortunately, I am not yet at liberty to describe this latest development, owing to the patent situation, but it can be stated that, by means of it, *any* degree of fineness of grain can be optically obtained, and there is no mechanical limit to the speed of the operation.



F. M. Delano, Jr., Paris

A FRENCH SCIENTIST'S REPORT TO "POPULAR RADIO"

"I have seen a demonstration of Mr. Baird's system of television. I saw the image of a youth on an illuminated screen. It was very small, but I could see him open and close his eyes and mouth, turn his head, and so on, as requested. Although the image was not perfect, the youth could be recognized. Without doubt, Mr. Baird has demonstrated true television."—GEN. GUSTAVE FERRIE.

One interesting phenomenon in connection with television is that if the output currents of the light-sensitive cell are listened to in a telephone receiver, they are heard as sounds, every object or scene having its own peculiar characteristic sound.

For example, the fingers of a hand held in front of the transmitter will give rise to a sound similar to the grating of a very coarse file, while the human face will cause a high-pitched whistle which will vary in pitch as the head is turned or even when the features are moved.

I have had a few phonograph records made of the "sounds" made by the faces of different persons; by listening carefully to the reproductions of these records it is possible to distinguish between one face and another by the sounds they make! With practice, faces may even be recognized by the sounds produced.

A further interesting point is that these records may be turned back into images by making them vary the current at the receiver, so that we can now store a living scene in the form of a phonograph record as well as in the form of a cinematograph film! There is room here for the imaginative to indulge in speculation on the scope for future development along these lines.

In the first demonstrations of television it was necessary to use an intensely brilliant illumination, and this caused the sitters considerable discomfort. I was told that even a vaudeville star would shrink from such an intense spotlight.

While working on reducing the light necessary, the thought occurred, why not dispense with light altogether and use rays outside the visible spectrum? But would the light-sensitive cell respond?

First of all I experimented with ultra-violet rays, but these proved troublesome

(*Continued on page 498*)

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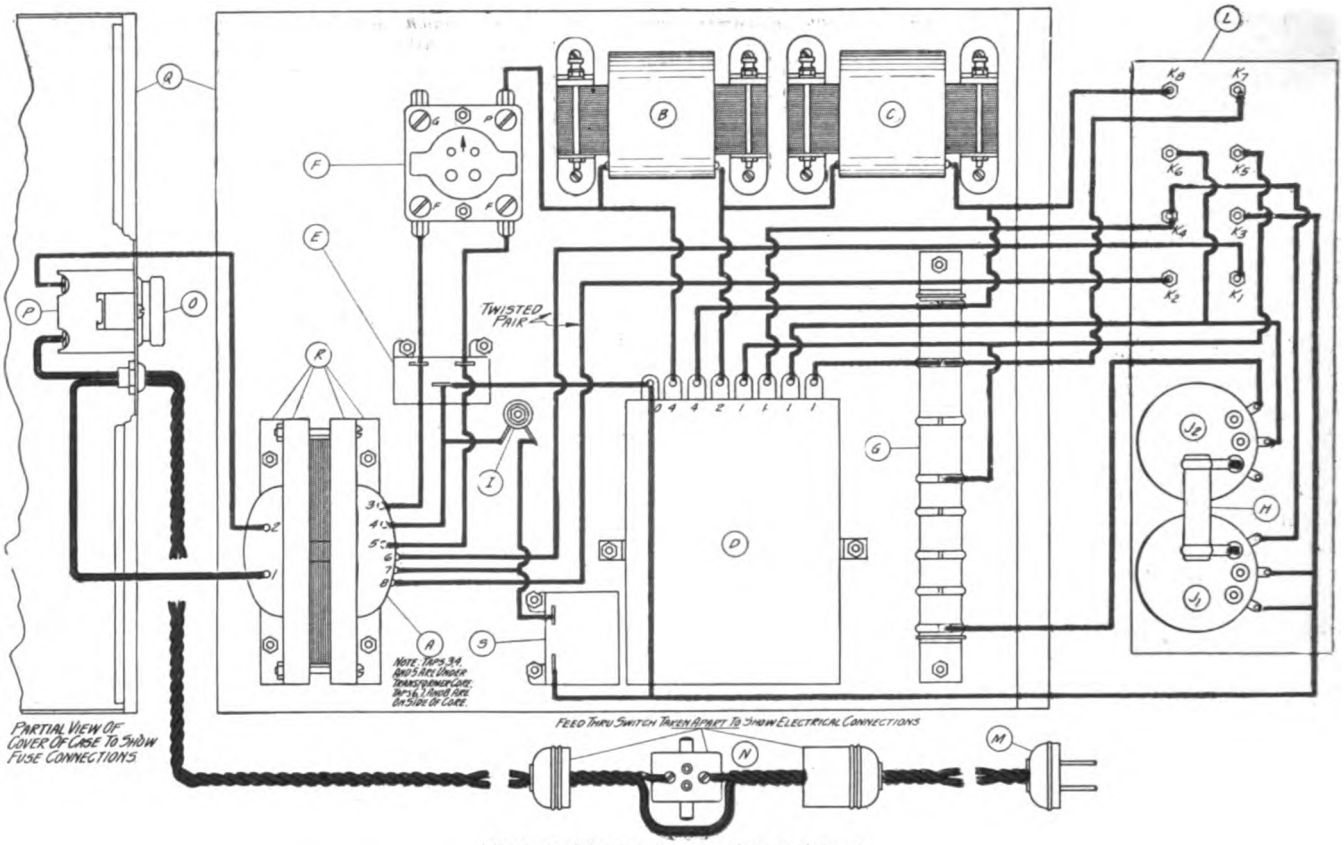
TWISTED PAIR
FEED THRU SWITCH TAKEN APART TO SHOW ELECTRICAL CONNECTIONS
PARTIAL VIEW OF COVER OF CASE TO SHOW FUSE CONNECTIONS

THE PICTURE WIRING DIAGRAM

FIGURE 1: *Here the wiring is shown in heavy* BLUE *lines; the instruments themselves and the various parts and accessories are drawn in* BLACK. *The rectangle at the right shows the connections to be made on the binding post panel, the large middle rectangle those to the instruments mounted on the bottom half of the metal case. At the left is indicated the wiring of the instruments on the top half of the case.*

How to Build the Varion Power-Pack

Here are the exact constructional details for building a high-powered unit that uses the gaseous type of full-wave rectifier tube. This unit will supply the proper voltages for any set. Simple construction and complete shielding are among its features.

By LAURENCE M. COCKADAY

COST OF PARTS: *Not more than $58.00*

HERE ARE THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS RECEIVER—

A—AmerTran transformer, PF-64 (unmounted);
B and C—Amerchokes, No. 854;
D—Sangamo Varion condenser block, 14 mfds. total capacity;
E—Sangamo Varion condenser block, (two .1 mfd. units with one common terminal);
F—Eby UX-type socket;
G—Ward-Leonard Varion resistance unit, 12,000 ohms total resistance;
H—Ward-Leonard resistance, 5000 ohms;
I—Ward-Leonard resistance, 2250 ohms;
J1 and J2—any approved heavy-duty potentiometers, 2000 ohms (Centralab units illustrated);
K1, K2, K3, K4, K5, K6, K7 and K8—any approved binding posts (Eby posts illustrated); marked Fil., Fil., "C" battery—, "B" battery—, "B" Det. +, 67-volt, 90-volt +, and "B" amplifier +, respectively;
L—Drilled and engraved bakelite panel, 2 inches by 9 inches by ⅛-inch;
M—Attachment plug;
N—Beaver Feed-thru switch;
O—Any approved fuse plug, 6 amperes (Economy plug illustrated);
P—Hart & Hegeman receptacle, No. 9154;
Q—Stamped and drilled metal case;
R—Mounting brackets for transformer;
S—Tobe filter condenser, 2 mfd.;
3 dozen—6/32 brass machine screws, ¾-inch long;
4 6/32 brass machine screws, 1½-inch long;
1 6/32 brass machine screw, 2½-inches long;
6 feet standard lamp cord.

MOST of the descriptive articles on power-packs have dealt with a construction wherein the various instruments used in the pack were to be mounted on a wooden baseboard. This style (commonly called "breadboard mounting") has proved satisfactory for amateur use. If the whole unit were to be assembled on a metal chassis that could be totally shielded so that the high-voltage wiring could be protected from the hands of the operator, there would be a considerable advantage, however.

This latter type of construction, which

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The list of parts given above includes the exact instruments used in the set from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

has been followed in the new unit, eliminates any possibility of electric shock to the operator of the set with which it is to be used.

In designing the new unit, special consideration was given to wide variation of intermediate voltages necessary on commercial types of receivers; therefore taps have been provided for voltages of 67-volts, 90-volts, and the high-voltage tap which goes up to 200-volts, as well as a variable voltage for the detector valve and a variable voltage for the last power tube.

A further feature of the new unit is the ability to supply alternating current at 5-volts for the UX-171 type power valve. By means of a simple adapter any set may use a power valve in the last stage and obtain its "A," "B" and "C" voltages direct from the power-pack, while the other vacuum valves in the set may be supplied from a storage battery or from an "A" power-pack.

The unit is also equipped with a fuse and an extension cord for plugging into the light socket with a separate switch for turning it "on" and "off."

The power-pack is designed especially for the use of the new gaseous rectifier valves and the following tubes have been approved for use with the unit:

1. Raytheon 85 mil. double-wave rectifier valve;
2. Q.R.S. 85 mil. double-wave rectifier valve;
3. Edlo BH double-wave rectifier valve;
4. Speed double-wave rectifier valve;
5. Schickerling double-wave rectifier valve.

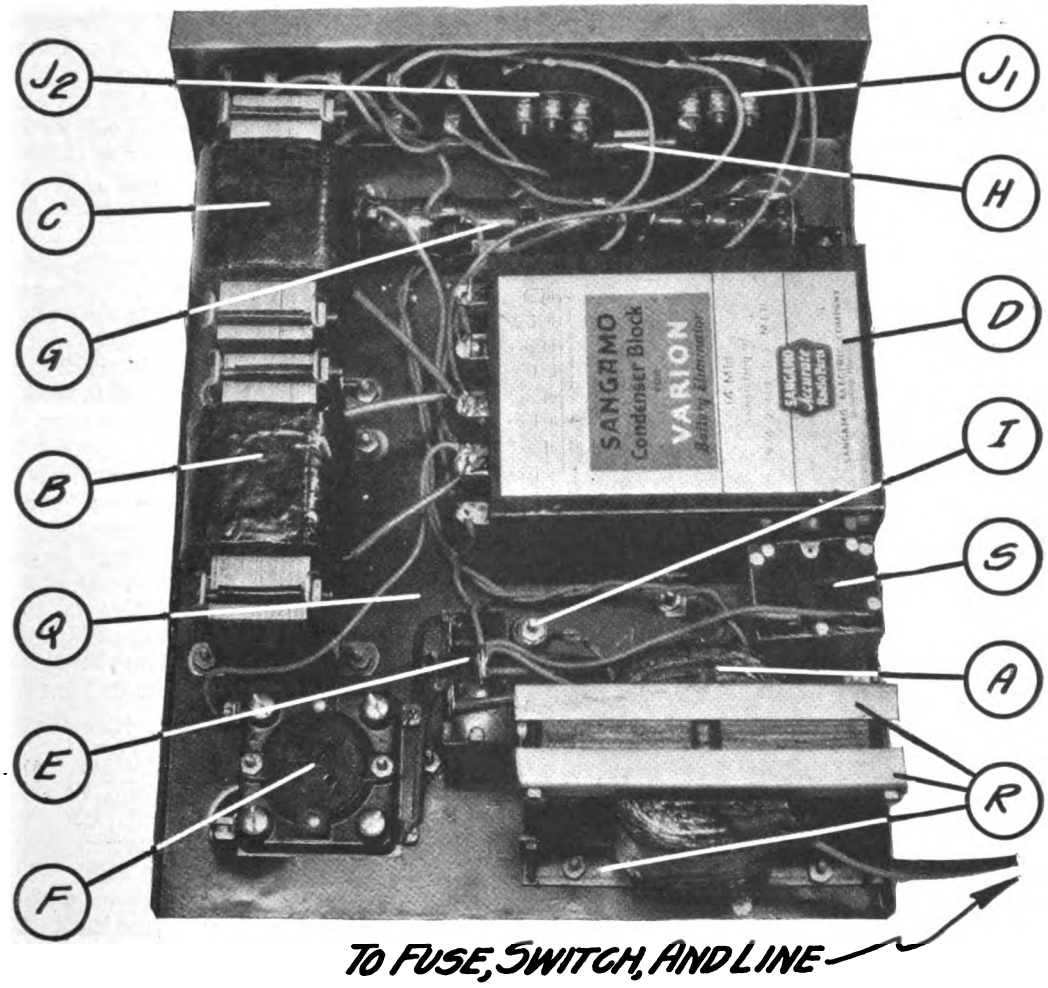
The condensers have been especially grouped into two compact blocks with handy terminals for wiring up. The resistance elements also have been made in special tapped units that make for simplicity in connection.

The Varion power-pack may be used to furnish power for any type of set now on the market or with any type of receiver that may be built by the experimental radio fan.

The circuit diagram for the power-pack is given in Figure 3.

How to Construct the Unit

After all the instruments and material for building the power-pack have



THE INNER ARRANGEMENT OF THE POWER-PACK

FIGURE 2: *The parts of the power-pack are screwed to the metal case in the simple arrangement pictured above, showing the pack with the top of the metal case off. (All of the parts shown in this illustration are designated by letters that correspond to the list of parts and the constructional data given in the text of the article.)*

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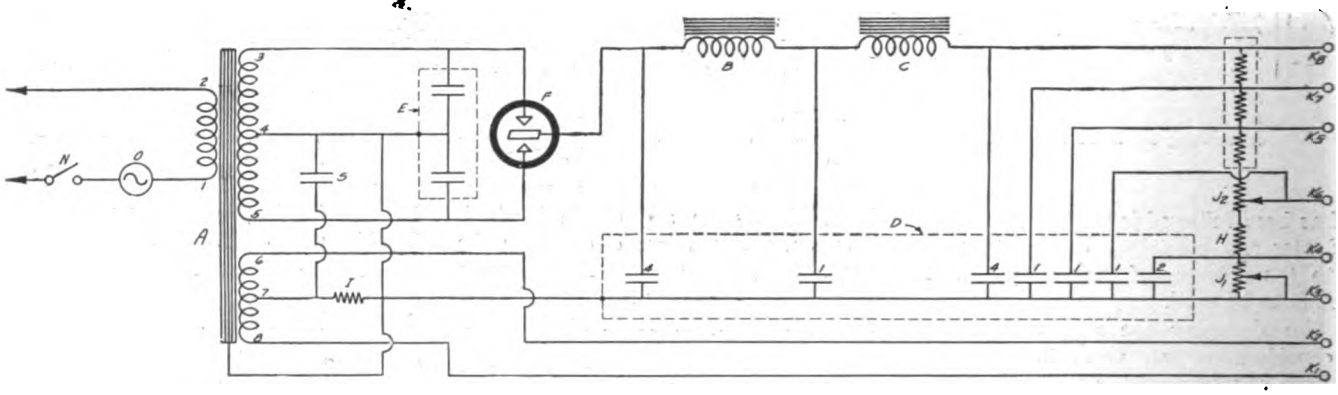
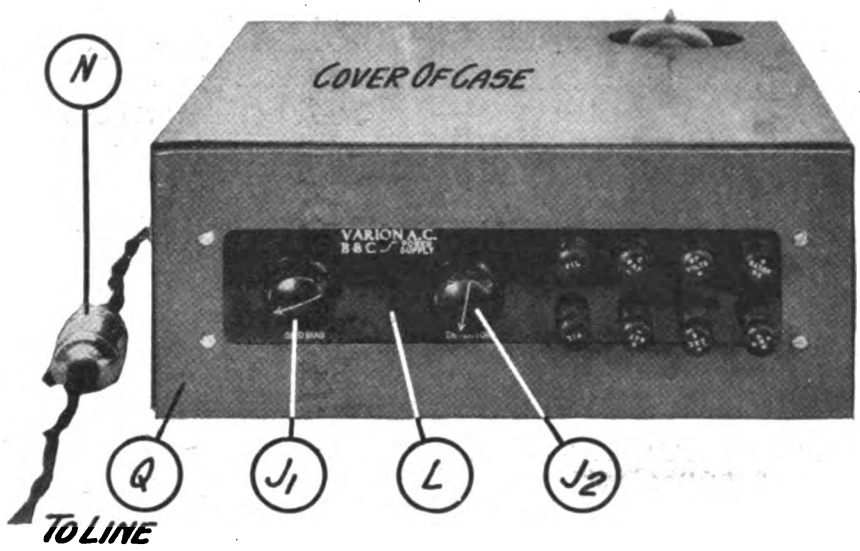


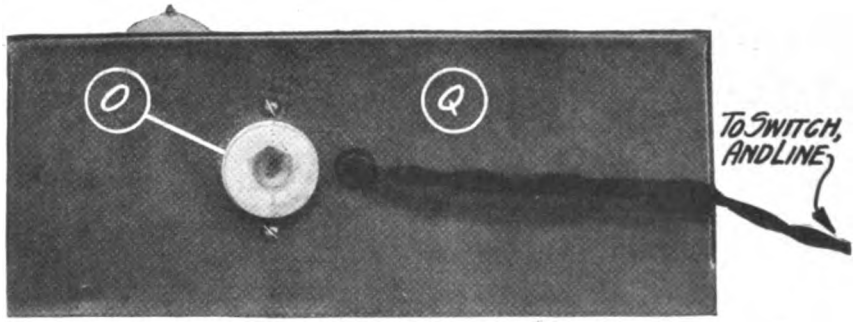
THE SCHEMATIC WIRING DIAGRAM

FIGURE 3: *This drawing gives the electrical circuit and connections of all the parts that are used in this new unit—a unit that is designed to give increased power and more stable operation when connected to a radio receiver.*



A FRONT VIEW OF THE UNIT

FIGURE 4: *At the left is the switch, N, which turns the unit "on" and "off." The two variable voltage controls, J1 and J2, are located on the small panel. The tube itself is inserted in the opening at the rear right-hand corner of the unit. The metal case completely covers all of the live parts of the unit.*



A REAR VIEW OF THE UNIT

FIGURE 5: *The fuse plug, O, is mounted on this end of the metal case, Q. The double wire goes to the switch, N, shown in Figure 4, and to the lighting socket plug that makes connection with the lighting lines. The power-pack is built to operate on an alternating circuit of 110 volts and from 50 to 60 cycles.*

been procured, the unit may best be put together in the following manner:

First of all, mount the binding posts, K1, K2, K3, K4, K5, K6, K7 and K8, on the small connection panel, L, and mount the two potentiometers, J1 and J2, as shown in Figures 1, 2, and 4.

The resistance, S, need not be mounted until the set is wired up.

When these parts have been mounted on the small panel, L, the panel may be fastened to the bottom half of the metal case, Q, by means of four machine screws and nuts.

Next, mount the resistance unit, G, on the metal case, Q, by means of two machine screws and nuts, as shown in Figure 1.

Then mount the two choke coils, B and C, in a similar manner.

Next, fasten down the large condenser block, D, and the two smaller condenser blocks, E and S. When this is done, fasten down the resistance, I, by inserting the long 2½-inch brass machine screw up through the base, and by placing a washer and nut at the top end.

Then mount the valve socket, F, first cutting out a small square of heavy cardboard, the same size as the base of the socket, and placing it between the socket and the metal case.

Lastly, attach the four brass brackets, R, to the transformer, A, as shown in Figure 8 and mount it in position, exactly as shown in Figure 1.

This completes the constructional work on the bottom half of the case, Q.

Next, fasten the receptacle, P, to the upper half of the case in the proper holes by means of the two machine screws that come with the unit.

The constructional work is now complete and the unit is ready to be wired.

How to Wire the Power-Pack

If the picture wiring diagram is followed in wiring up this unit, the job will be found to be an easy one. Use a rubber covered hook-up wire or a flexible wire such as Celatsite for this work. Follow the connections shown in the picture wiring diagram in Figure 1 exactly and no difficulty will be experienced.

When wiring up the connections to the binding posts, it would be advisable to take out the choke coil nearest the panel while this work is being done,

(*Continued on page 495*)

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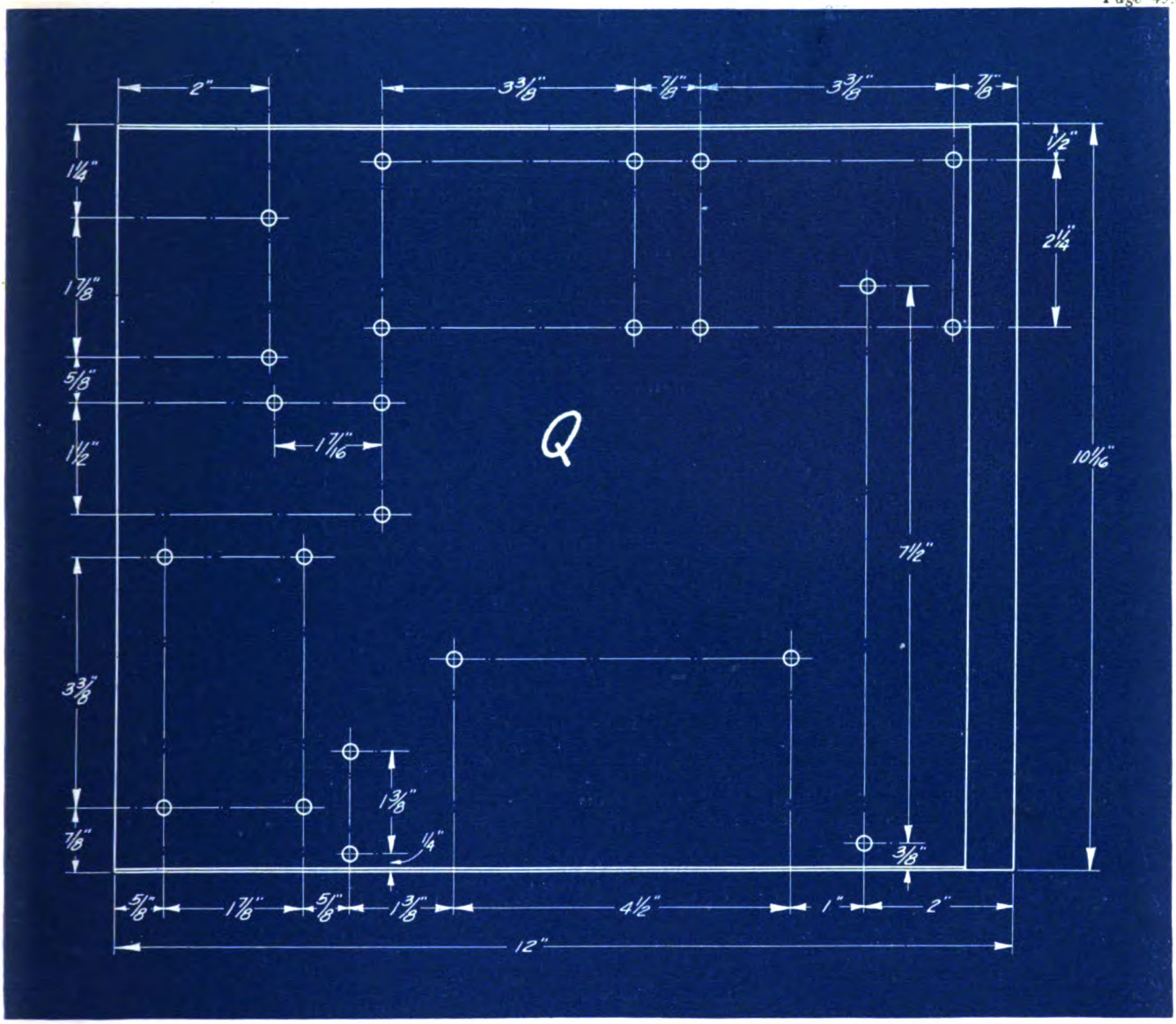
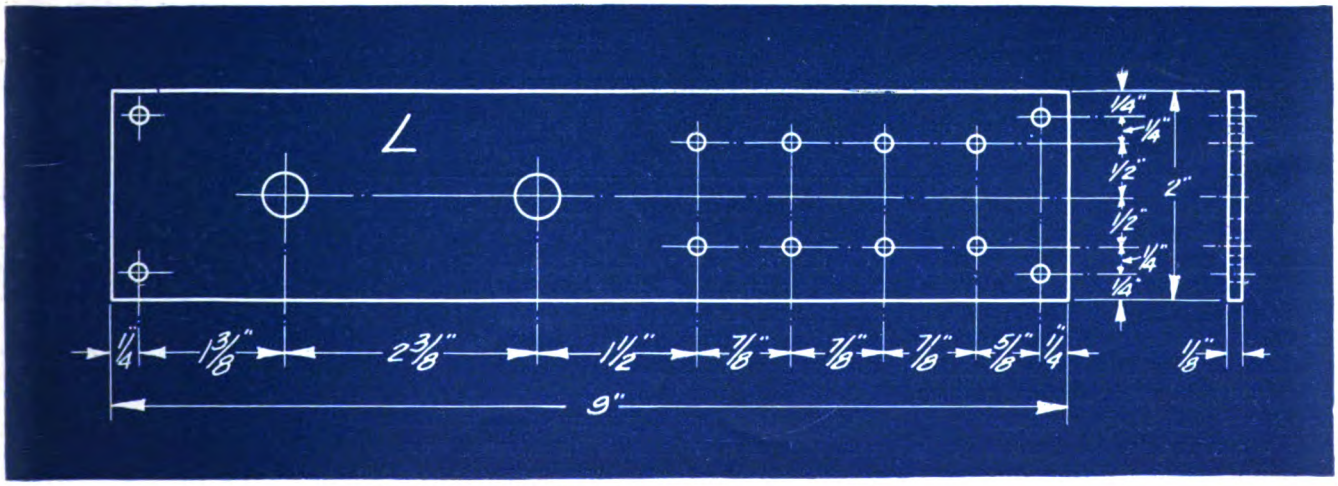


THE DRILLING PLAN FOR THE BOTTOM HALF OF THE CASE Q

FIGURE 6: *This shows the exact positions of all the holes for mounting the instruments on the bottom half of the metal case. The holes should be drilled with the correct size of drill, for easily fastening the screws that are used in mounting the instruments.*



THE DRILLING PLAN FOR THE SMALL PANEL L

FIGURE 7: *The dimensions and layout for the holes used in mounting the instruments and binding posts are clearly indicated. The sizes of the holes should be determined beforehand by measuring the sizes of the screws on the binding posts and the shafts of the two instruments that are to be mounted on this panel.*

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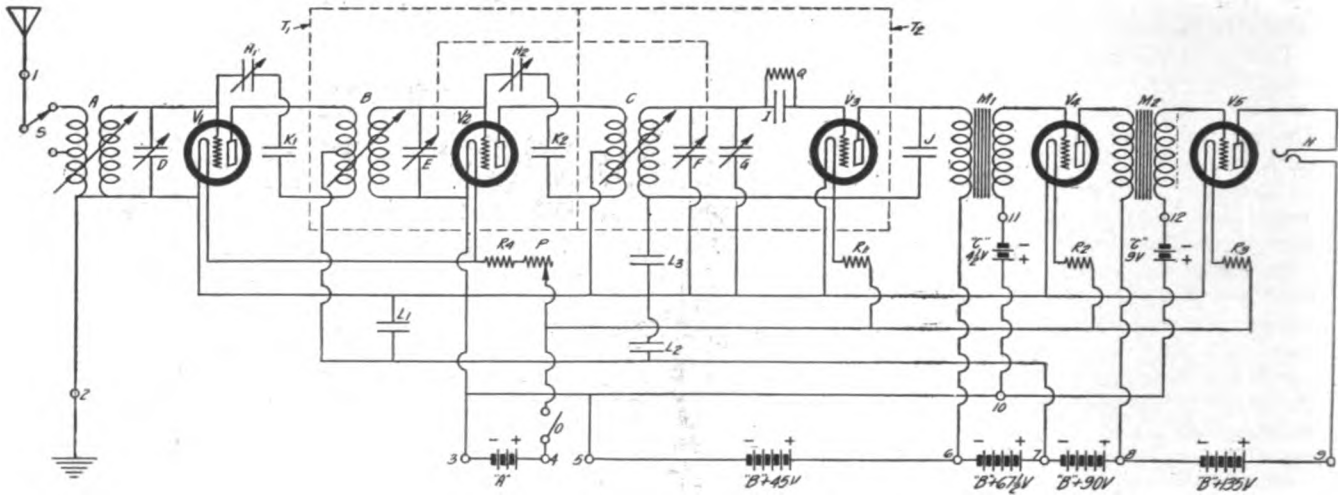

DIAGRAM OF THE ELECTRICAL CIRCUIT

FIGURE 1: *Here is shown the theoretical wiring of the Hi-Q receiver. Notice that the second stage of high-frequency amplification and the detector are shielded with complete stage shields and that the condensers, E and F, mounted on these shields are connected by a single-control tuning knob and shaft.*

HOW TO ASSEMBLE

The Hammarlund-Roberts Hi-Q Receiver

This series of articles on the assembly and operation of popular kits of parts that may be obtained for building really good radio receivers will differ from the "How-to-Build" articles, in that the sets described have been designed outside of POPULAR RADIO Experimental Laboratory by commercial engineers. The sets that will be picked for description, however, will have been carefully tested in the POPULAR RADIO Electrical Testing Laboratory and will be chosen for their outstanding features and all-around efficiency.

By JOSEPH CALCATERRA

COST OF PARTS: *Not more than $63.50*

HERE IS A LIST OF THE PARTS RECOMMENDED FOR THE CONSTRUCTION OF THE RECEIVER—

A, B and C—Set of Hammarlund auto-couple coils;
D, E and F—Hammarlund midline variable condensers, .00035 mfd.;
G—Hammarlund Jr. variable condenser, 32 mmfd.;
H1 and H2—Hammarlund equalizer condensers;*
I—Sangamo grid condenser with grid-leak mounting clips, .00025 mfd.;
J—Sangamo fixed condenser, .001 mfd.;
K1 and K2—Sangamo fixed condensers, .00015 mfd.;
L1, L2 and L3—Sangamo by-pass condensers, ¼ mfd.;
M1 and M2—Samson low-frequency transformers, 3 to 1 ratio, type HW-A3;
N—Carter short jack, No. 1;
OP—Carter combination midget rheostat (10 ohms) with filament switch, No. M-10-S;
Q—Durham metallized resistor, 2 megohms;
R1 and R2—Amperites, No. 1A;
R3—Amperite (No. 1A for UX-201-a type valve; No. 112 for UX-112 or UX-171 type valves);
R4—Fixed resistance, 2 ohms (supplied in foundation unit);*
S—Carter "Imp" antenna switch, No. 12;
T1 and T2—Shields;*
U—Composition panel, drilled and engraved;*
V1, V2 and V3—Benjamin sockets, No. 9040;
V4 and V5—Benjamin sockets without bases, No. 9049;
W—Hardwood baseboard;
X—Composition sub-panel;*
Y1 and Y2—Marco vernier dials, No. 192;
Z—"Ebco" Hi-Q cabinet;
10 binding posts.

* The Hammarlund-Roberts foundation unit includes drilled and engraved panel, U, and sub-panel, X, shields, T1 and T2, equalizers, H1 and H2, extension shaft, resistance unit, R4, screws, nuts, etc.

THE Hammarlund-Roberts Hi-Q circuit is the result of a concerted effort to produce a receiver which would be simple to operate; that would be non-oscillating, selective, give even amplification over the whole wavelength range and be adaptable for use under all ordinary conditions of location, antenna length and skill of the operator.

This receiver is, fundamentally, a five-valve tuned high-frequency receiver taking advantage of the good points usually found in this type of circuit but so designed as to eliminate the bad features that have caused many fans to frown on the ordinary tuned-high-frequency set.

In the first place, the ordinary receiver makes no provision for a variation in the antenna length of the individual installation or for its distance from the broadcasting stations.

In the Hi-Q receiver this is taken care of by using a tapped primary winding permitting an adjustment of the number of turns in the antenna circuit and a consequent variation of coupling and transfer of energy. In this manner it is possible to adjust the receiver for operation on a long antenna by reducing the number of turns of the primary winding or adjust it for operation on a short antenna by increasing the number of turns in the antenna circuit. A two-point antenna switch, S, is used for the switching operation.

While there are three tuned circuits in the receiver, simplicity of tuning has been accomplished by ganging the second and third variable condensers, E and F, on one shaft. Any slight variation in the two condensers may be balanced up by adjusting the auxiliary tuning condenser, G, which, when once properly adjusted, need never be touched again.

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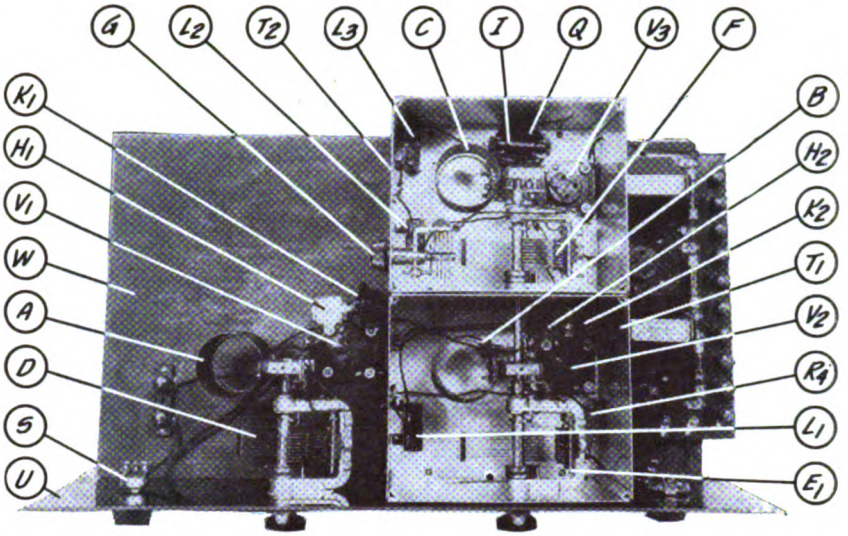
The positions of these parts is shown clearly in Figures 2 and 3.

Up to this stage there is little difference between the Hi-Q and many of the other tuned-high-frequency circuits. The real secret behind the remarkable efficiency of the circuit lies in a novel departure from ordinary practice in the design and operation of the high-frequency transformers in this receiver.

Instead of the usual arrangement of a fixed coupling between primary and secondary windings, these high-frequency transformers employ variable coupling between the two windings. By this means it is possible to overcome the disadvantages growing out of the old system.

With these variable-coupling transformers, it is possible to increase the coupling to the point where maximum efficiency is obtainable at high wavelengths, using a large number of turns and tight coupling, without risking unstable operation and oscillation at the low wavelengths. When the receiver is tuned to lower wavelengths, the coupling is automatically decreased or "loosened"; this reduces energy transfer and prevents unstable operation or chocking of the vacuum valves.

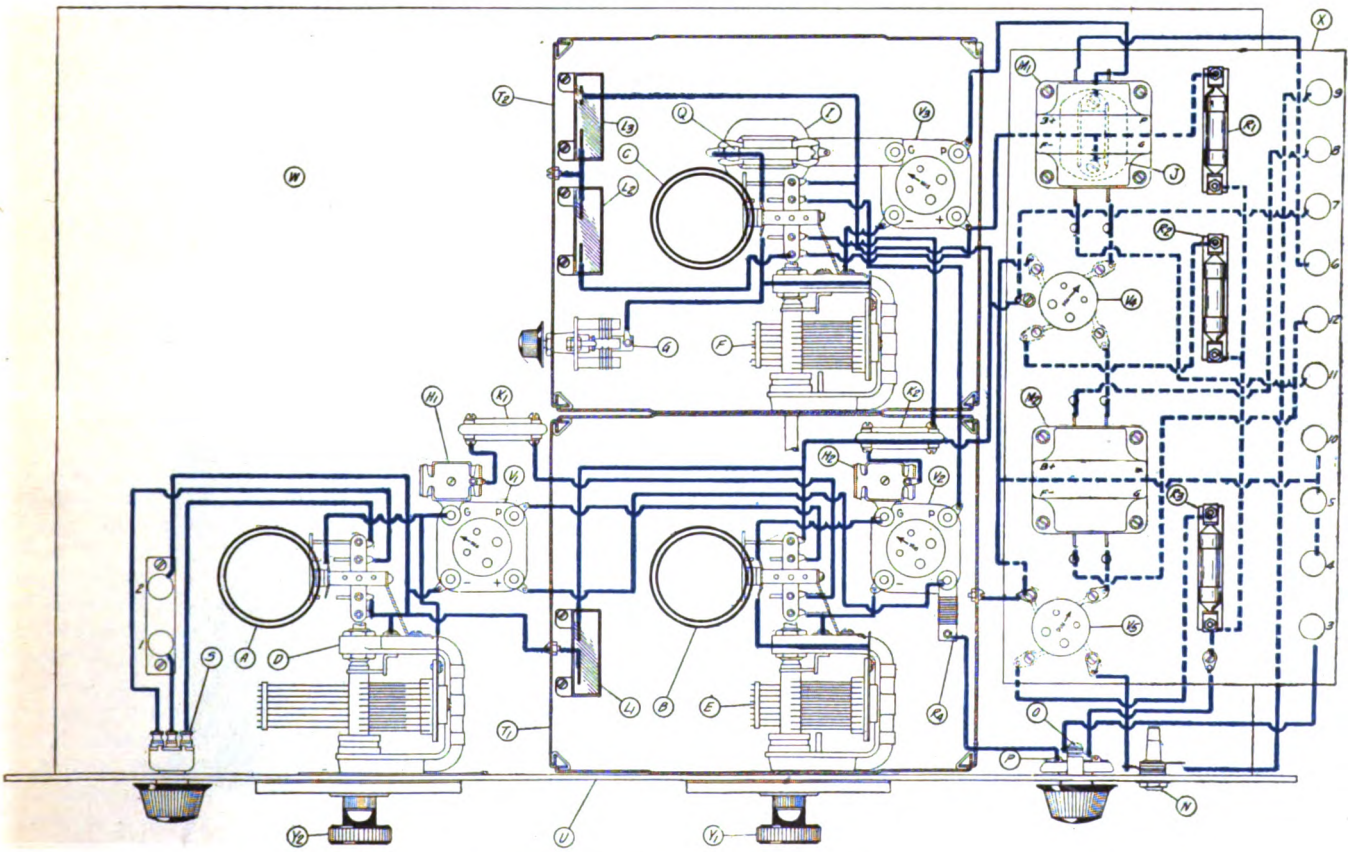


A VIEW OF THE RECEIVER FROM ABOVE

FIGURE 2: *This shows the general arrangement of the complete receiver, with the top portions of the two shields removed so that the parts mounted inside may be seen.*

This variation of coupling is accomplished through an ingenious cam arrangement by means of which the primary coil is made to change its relationship to the secondary winding as the variable condenser is adjusted throughout its range. By the scientific design of the cam, the coupling of the coils is adjusted to the best point for each wavelength setting of the variable condenser on which the coil is mounted.

This automatic variation of coupling



THE PICTURE WIRING DIAGRAM

FIGURE 3: *In this drawing all of the parts that are mounted in vision are drawn in* BLACK *lines. The fixed condenser, J, shown in dotted* BLACK *lines at the upper right-hand corner of the diagram, is mounted underneath the first transformer. All of the wiring that is in view is shown in solid, heavy* BLUE *lines and the wiring beneath the low-frequency panel at the right is shown in dotted* BLUE *lines*

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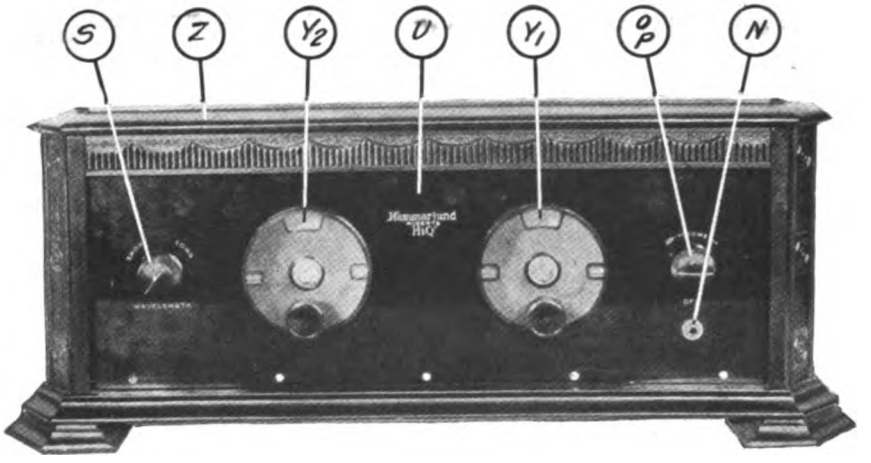


A FRONT VIEW OF THE HI-Q

FIGURE 4: *The various controls on the panel of the Hi-Q are marked with letters which correspond with the lists of parts given at the beginning of this article.*

provides a simple but efficient method of obtaining maximum amplification throughout the whole wavelength range.

Another feature that is worthy of mention is the method used to eliminate oscillation because of feedback through the vacuum valves. The primaries of the high-frequency transformers are wound in one direction, but are tapped so that it is possible to connect the circuits to produce neutralization of the vacuum valve capacities in tubes V1 and V2, and prevent the howling and radiation nuisance so common in ordinary tuned-high-frequency receivers. Stabilization is obtained by adjustment of the equalizer condensers, H1 and H2, shown schematically in Figure 1.

The designers were aware of the increased "kick" that could be obtained by the use of a regenerative detector but they knew too the regenerative detector's tendency to produce distortion through sideband cutting, a type of distortion that gives disagreeable results in the quality of tone obtained from the reproducer. The increased gain obtained in the high-frequency stages by the variable coupling more than offsets any loss that might be caused by not using a regenerative detector, without sacrificing quality of reproduction.

Efficient volume control from minimum to maximum without danger of operating the valves at more than their rated voltage, is obtained by the series combination of a 2-ohm fixed resistance, R4, and a 10-ohm rheostat, P. The fixed resistance makes it impossible to put the full 6 volts of the "A" battery across the filament terminals of the high-frequency valves. While a rheostat should not be used as a volume control in the detector or low-frequency stages, it provides an efficient volume control in the high-frequency filament circuits. Figure 1 shows the positions of these units in the circuit.

The high impedances of the primary windings of the low-frequency transformers selected for this circuit insure faithful reproduction of speech and musical tones. The helical winding used in the secondary windings reduces distributed capacity to a minimum and eliminates muffling effects so often obtained with transformers having high distributed capacities.

Complete shielding of the second high-frequency stage and the detector stage prevents intercoupling between the circuits and also reduces external pickup to a minimum; this provides exceptional selectivity. The first high-frequency stage may also be shielded if desired; however, this is not really necessary.

A UX-112 or a UX-171 type valve should be used in the last stage socket, V5, if really good volume and quality is desired, although it is possible to use an ordinary type of amplifier valve in this stage with good results. Either a UX-201-a or a UX-200-a type valve may be used in the detector stage socket, V3, although a UX-200-a type tube is more sensitive and will give better results on distant stations.

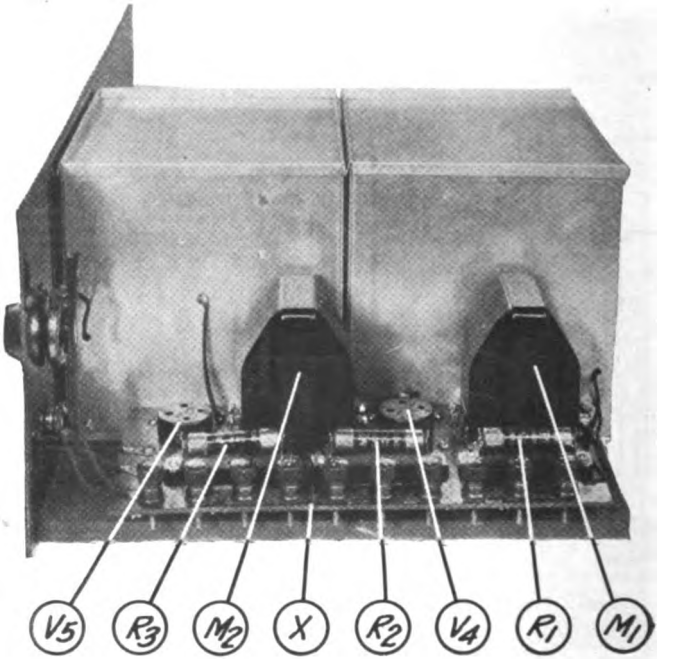
In mounting the parts and wiring the receiver, it is a good plan to mount all the parts and make all possible connections on the detector and low-frequency unit sub-panel before mounting it on the receiver baseboard. In this way the mounting of the parts and wiring will be much simplified.

Then mount the front panel on the edge of the baseboard. Next, mount the Auto-couple coils on the condensers. Mount variable condenser, D. Next, mount the other two variable condensers on a common shaft with the shield walls serving as a support between the two condensers. Place the bottoms of the shields in place on the baseboard and mount the two sockets in place.

Then, mount the other parts in their proper places, as shown in Figure 3, and proceed with the wiring. The sides of the shields should not be put in place until all the preliminary connections to terminals which will be difficult to get at later, are made. Figure 3 also gives the wiring scheme.

Use solder in making your con-

(*Continued on page 479*)



A VIEW OF THE SET FROM THE LOW-FREQUENCY END

FIGURE 5: *Here is shown the low-frequency amplifier in position at the side of the two box shields. The binding posts run along the edge.*

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SOME OF THE EXTRAORDINARY

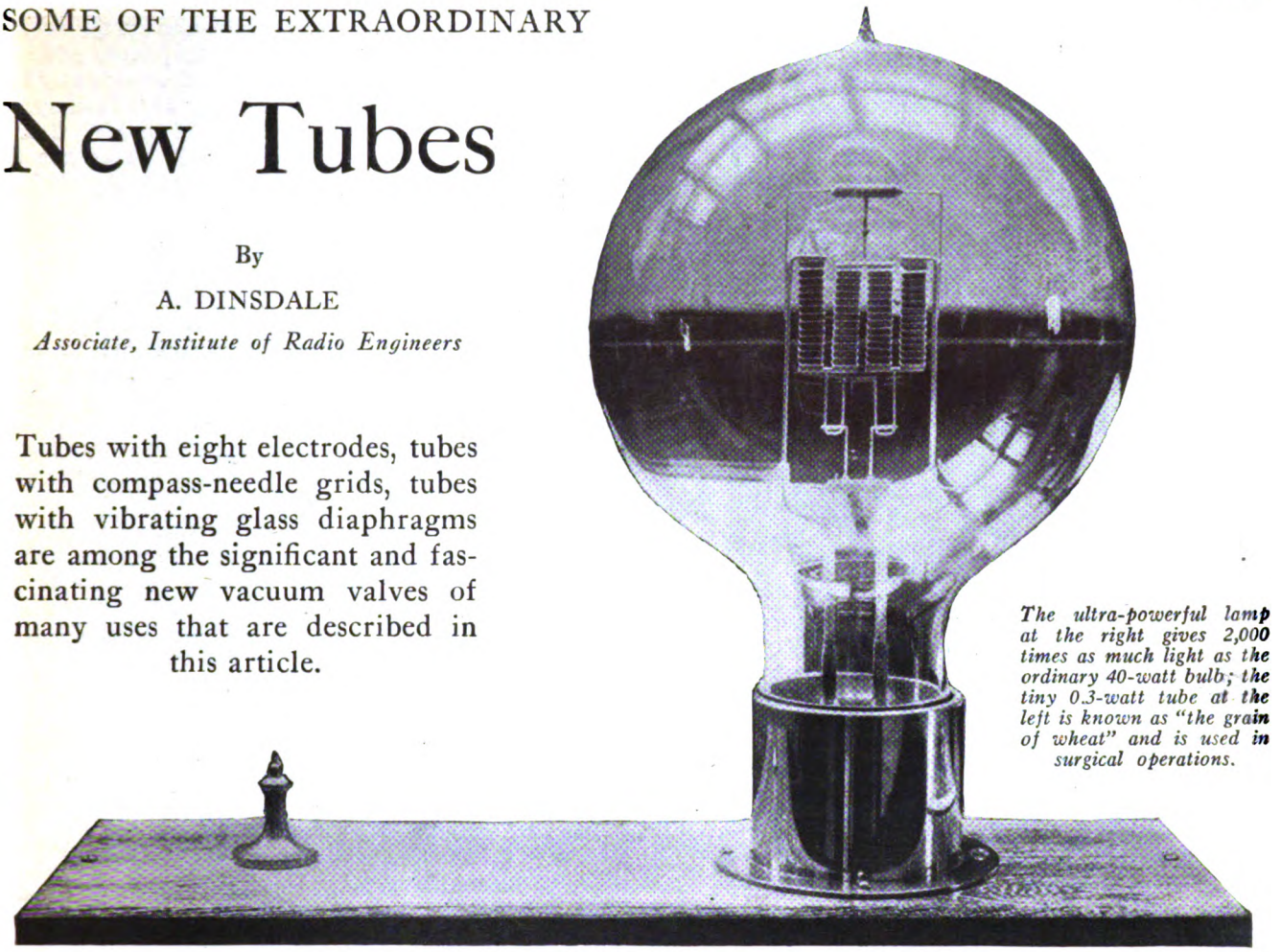
New Tubes

By

A. DINSDALE

Associate, Institute of Radio Engineers

Tubes with eight electrodes, tubes with compass-needle grids, tubes with vibrating glass diaphragms are among the significant and fascinating new vacuum valves of many uses that are described in this article.



The ultra-powerful lamp at the right gives 2,000 times as much light as the ordinary 40-watt bulb; the tiny 0.3-watt tube at the left is known as "the grain of wheat" and is used in surgical operations.

A READING of patent records is usually a dry proceeding—a necessary evil to be done with as quickly as possible.

But occasionally one comes across some novel and interesting invention. During the past few months particularly, some very curious designs of vacuum valves (or "thermionic valves" as they are more properly called) have made their appearance.

It has been said that there is no limit to the possibilities of the thermionic valve. In radio today these valves range from the miniature peanut tube, which amplifies only the most minute amount of electrical energy, up to great water-cooled or oil-cooled leviathans which are capable of handling 1,000 kilowatts each. Such giants, of course, are only used in the very largest transoceanic radiotelegraph stations.

Beyond the realms of radio, however, the thermionic valve is beginning to be used for a rapidly increasing variety of purposes; for many of these the ordinary valves are not suitable. For many special applications in radio, also, the ordinary valve is unfitted; in consequence there is an increasing demand for freaks for all sorts of special purposes.

At the present time there are scores of things that a vacuum valve can do besides making broadcasting audible to listeners in.

It can, for example, be used to control dynamos and similar electrical equipment, to regulate electric power systems, to actuate fire and burglar alarms and, in fact, to replace existing forms of relays of many varieties.

A Tube with Eight Electrodes

A few moments' consideration of some of the ingenious suggestions which have been made for improving the thermionic vacuum valve and extending its sphere of usefulness will indicate the lines upon which future developments may be expected. For instance:

Four-electrode vacuum valves are commonplace nowadays, but in Figure 1 we have a valve that has no less than eight electrodes!

This extraordinary valve is the invention of Captain H. J. Round, the well-known British research engineer. Between the filament and plate of this extraordinary valve are placed six grids, three of which, G1, G2 and G3, are connected to the "B" battery negative as usual, while the other three, P1, P2 and P3, act as auxiliary plates, and are connected to "B" positive.

The input from the antenna is coupled at A to the grid, G1, and the amplified output from P1 is fed back through the transformer Q1 to the second grid, G2. The doubly-amplified output from P2 is then transferred, for a third stage of amplification, through the transformer, Q2, to the grid, G3. If the latter grid is suitably adjusted, by means of a potentiometer or grid-leak, rectification will also be effected, and the final output of P3 will be passed on to the low-frequency amplifying transformer.

As a contrast to this device, Figure 2 shows a form of valve fitted with a large number of separate plates, P. This valve is designed to act as an ultra-rapid interrupter, or switch.

The electron stream from the filament, F, is controlled by means of the two condenser plates, C and C1, which are charged from an oscillatory source of voltage. This oscillatory charging causes the electron stream to be swung rapidly across the series of insulated plates, P, in turn, thus energizing the different circuits to which they are connected.

This particular form of vacuum valve is employed in a method for determining the height of an airplane or the depth be-

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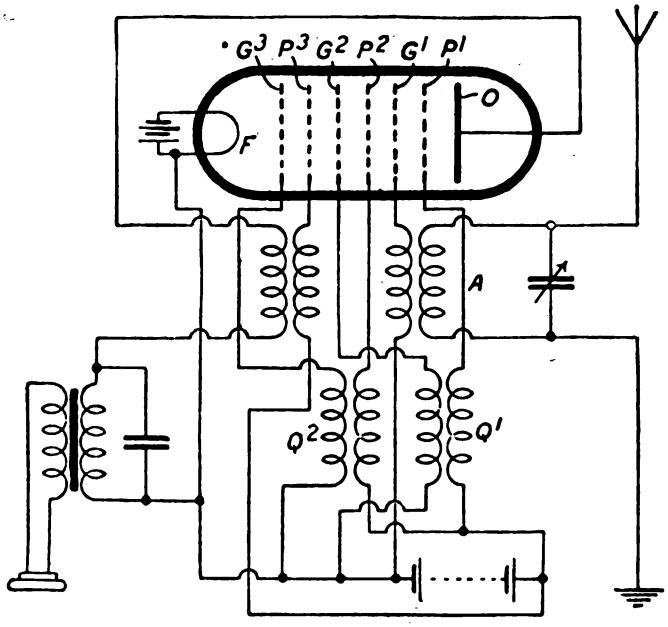


A MULTIPLE GRID TUBE

FIGURE 1: *In this circuit, employing a special vacuum valve with six grids, a number of stages of high-frequency amplification are possible.*

low the surface of the ground of a mass of conducting material—such as mineral ores. In this method the time taken by an electromagnetic wave to reach the given object and to be reflected back again is measured, and as the time interval is necessarily extremely brief, some special form of interrupter, such as that shown, must be employed to open and close the transmission and reception circuits alternately at a high rate of speed.

A Tube for Controlling an Airplane

Figures 3 and 4 show apparatus, based on the thermionic vacuum valve principle, designed to automatically control airplanes or ships.

In this invention the basic principle is the use of a magnetic-compass needle as a grid of a special form of vacuum valve, so that any movement of the airplane or ship to one side or other of its appointed course will cause the compass-needle to swing towards either one plate or the other of the valve. This upsets the balance of the two plate currents, for, with the movement of the grid, more electrons will be enabled to reach one of the plates. This increased plate current is used to bring the airplane back automatically to its appointed course.

As shown in end section in Figure 3, the filament is directly above the moving compass-needle grid. Figure 4 shows this perhaps more clearly still. The two plates are mounted one on each side, and below, the swinging grid.

In the normal position, as set before the machine leaves the ground, the electron stream from the filament is shared equally by the two plates, P and P1, and equal currents therefore flow through the two electromagnets, M and M1, in the plate circuits.

If the airplane or ship deviates from her course to even a slight extent, the compass-needle grid, maintaining its fixed position in space, will move closer to one or the other of plates P or P1.

As the grid is given a positive bias by means of the tapping, T, the current through the nearest plate will increase, owing to the attraction on the electron stream exerted by the positive grid; this increased current will consequently flow through the windings of the corresponding electromagnet, M or M1. This is arranged automatically to operate the rudder and thus bring the airplane back on to her course.

A Vacuum Valve as a Microphone

Another somewhat similar application of the moving-grid principle is shown in Figure 5, which illustrates what might be called a "vibrating-grid microphone."

The upper surface of the ordinary glass bulb is flattened out as indicated at S, and it is sufficiently flexible to act as a diaphragm.

The grid, G, is flexibly mounted inside the bulb on a supporting arm, and is rigidly attached by a small pin to the center of the flattened glass diaphragm. This pin passes through a small hole in the center of the plate, P.

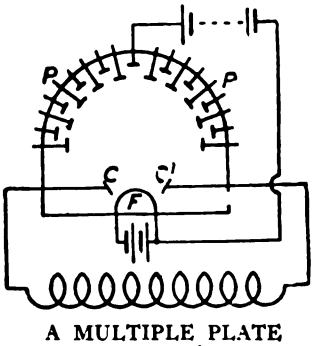
The entire device is supported and enclosed in an outer shield or mounting, M, constructed of cork or some other nonresonant substance, so as to protect the tube from outside mechanical disturbances.

The effect of speaking near the glass surface, S, is to cause the latter to vibrate in sympathy with the low-frequency sound waves in the air, exactly in the same fashion as an ordinary microphone operates.

The vibrations of the glass diaphragm are communicated to the movable grid, G, so that its relative distance from the plate and filament is varied accordingly. In turn this variation of distance varies the intensity of the plate current, causing microphonic variations which correspond to the applied speech waves.

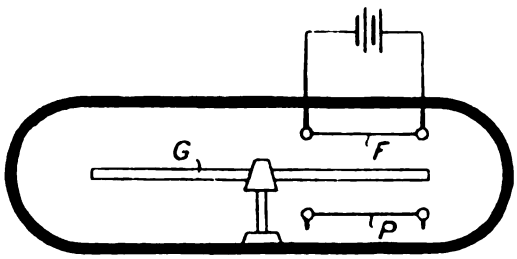
The varying output of this device may then be amplified and applied to a broadcast transmitter in the usual way.

(*Continued on page 499*)



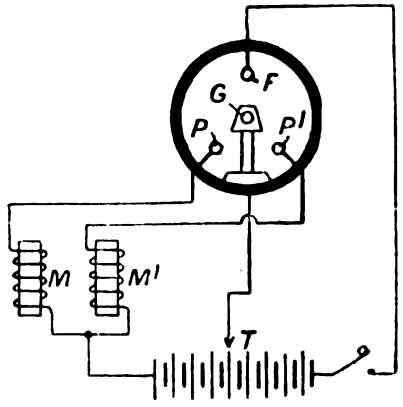
A MULTIPLE PLATE VALVE

FIGURE 2: *Another vacuum valve with multiple electrodes that has many interesting possibilities for experimenters.*



A TUBE FOR CONTROLLING AIRPLANES

FIGURE 3: *A still further development of the vacuum tube that has a movable compass-needle grid and two plates.*



A UNIQUE TUBE IN CIRCUIT

FIGURE 4: *This view of the tube shown in Figure 3 gives a more complete idea of the circuit.*

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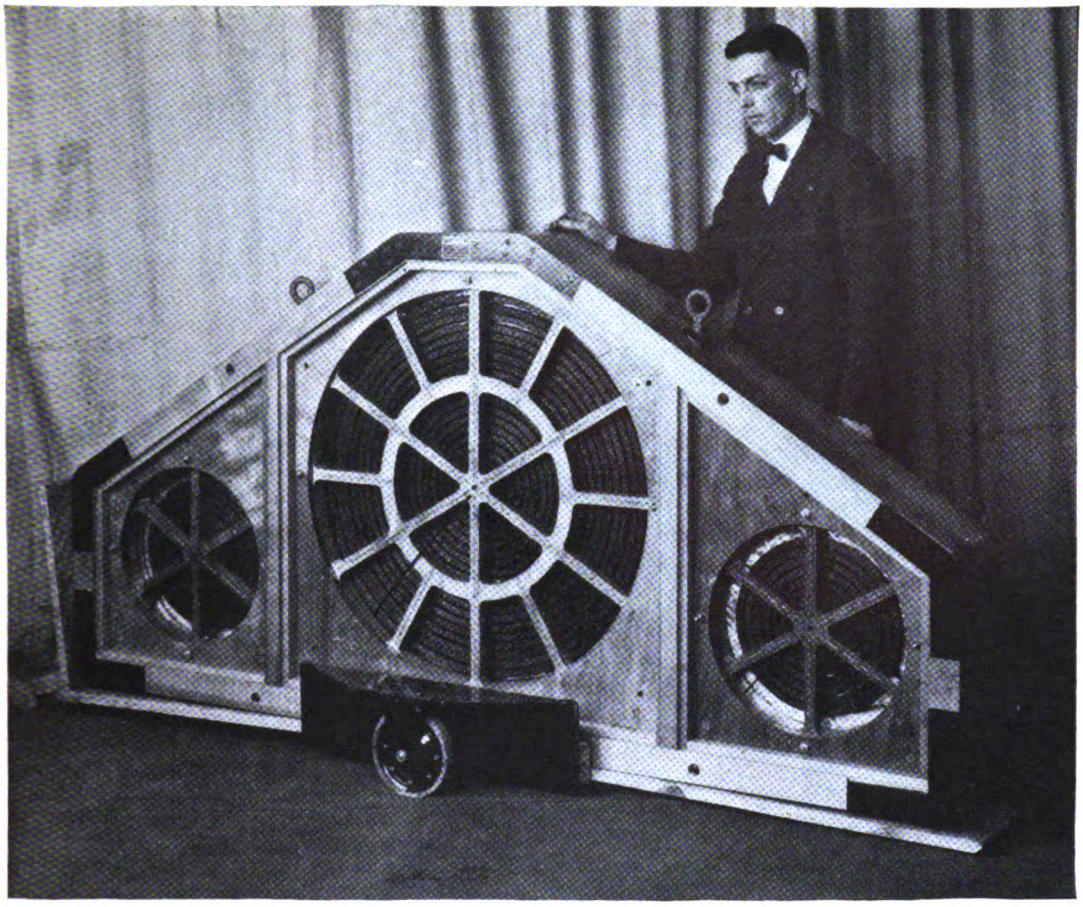

A NEW AND POWERFUL MULTIPLE LOUDSPEAKER

This new device, built on the Hewitt principle, consists of one large cone and two smaller ones and will cover the whole range of frequencies used in the reproduction of voice and music. It is powerful enough to supply radio programs to buildings as large as the new Madison Square Garden.

What's New *in* Radio

Conducted by

THE TECHNICAL STAFF

Inventors, experimenters, manufacturers and readers generally are invited to keep POPULAR RADIO informed of all new apparatus that is of their own creation or that comes to their attention; if the apparatus passes the tests of the POPULAR RADIO LABORATORY, it will be duly recorded in this Department.

Battery Connections May Be Safely and Simply Made with This Cable Equipment

Name of instrument: Battery cable and connector plug.

Description: This 5-foot cable, which bears the manufacturer's type No. 660, contains seven wires. These wires are coded and each is clearly labeled to indicate the battery terminal to which it is to be connected. The cable sheath terminates approximately two feet from one end of the wires; this provides ample slack to reach all of the battery terminals. The other end of the cable terminates in a bakelite socket. This socket has seven holes in one end, through which the pins of the plug portion of the connector project to make the seven individual contacts required in connecting the two halves of the connector together. The plug serves as a terminal for seven wires, which are to be connected to the various circuits in the receiver. These wires are also coded and labeled to correspond with the wires in the longer portion of the cable.

Usage: For connecting the batteries or power-packs to a receiver.

Outstanding features: All batteries can be instantly disconnected from the receiver by pulling the plug out of the socket. In connecting up batteries to the cable, if the plug is removed from the socket, there is no possibility of short-circuits resulting from loose ends of wires flopping around. The socket end of the cable (which is the "live" end) is completely encased in the socket; this further eliminates the chance of short-circuits. All wires are clearly labeled with stamped metal markers. The over-all length of the cable, when the plug is in the socket, is 6 feet. Each of the wires is well insulated and, except at the ends, all the wires are tightly bound in a cotton sheathing.

Maker: Yaxley Manufacturing Co.

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P. & A. Photos

Grandfather Can Tune in With This Receiver

Concealed in this grandfather's clock is a complete five-tube receiving set. Note the two-dial control and the loudspeaker located just under the face of the clock. This clock was one of the displays at a manufacturers' exhibit near London.

An Instrument That Prolongs Tube Life

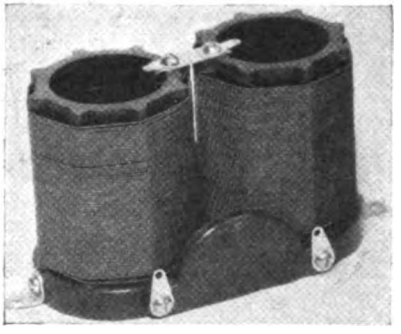
Name of instrument: Vacuum-valve rejuvenator.

Description: This device contains a step-down transformer and the necessary resistance units. These are completely enclosed in a metal case which is equipped with an extension cord and plug for insertion into an AC lamp socket. Binding posts are provided for making connections to the receiver and there is a switch on the front of the case that controls the voltage applied to the vacuum valves during the rejuvenating process. The tubes to be rejuvenated are left in their sockets in the receiver and are all put through the process at the same time. If they are of the 5-volt type, one pair of binding posts on the case of the rejuvenator is connected to the "A" battery binding post on the receiver, after the "A" battery has been disconnected. If the receiver employs 3-volt valves, connections are made the same way except that there is a separate pair of binding posts on the rejuvenator to provide the proper voltage for these valves.

Usage: To increase the electron emission of vacuum valve filament after it has become depleted, due to long use or the application of excessive filament voltage. This device may be used to rejuvenate only those valves that contain thoriated filaments. These include the UX-201-a, UX-200-a, UX-171 and UX-199 types of valves.

Outstanding features: Several valves may be rejuvenated at one time. Sturdy construction. Well made electrically. Simple to operate. Completely enclosed.

Maker: Jefferson Electric Mfg. Co.



A High-efficiency High-frequency Transformer

Name of instrument: "Duoformer" high-frequency transformer.

Description: The winding of this transformer is of the double-coil, semi-torodial type. Each coil is wound on a ribbed form, with the insulating material between ribs cut out except for a distance of ¼ inch from the top of the form. There the coil form is left in the form of a ring to provide a rigid support for the rib construction. The result of this arrangement is a highly efficient coil, with low losses. The primary winding is on a composition tube which is placed inside of the larger coils. The four terminals of the transformer are located at the bottom of the instrument, right at the ends of the secondary windings. This makes for short leads inside of the coil, and also facilitates the external circuit wiring. The two coils are held rigidly together by a metal connector at the top and by two composition strips at the bottom.

Usage: As the coupling device between the high-frequency amplifier valves in a receiver which makes use of one or more stages of this type of amplification.

Outstanding features: High efficiency. Small size. Well designed. Easy to wire up in a receiver.

Maker: Camfield Radio Mfg. Co.

A Handy Unit for High-Voltage Power-Packs and Power Amplifiers

Name of instrument: Power "compact," type R-210.

Description: This instrument contains a power transformer to supply the high voltage and also the filament voltages required for rectifier and power amplifier valves of the UX-216-B and the UX-210 types. It also includes two filter-choke coils and two buffer condensers. All of this apparatus is enclosed in a metal case, which is filled with an insulating compound. Many of the connections ordinarily required in a power-pack are already made inside of this case. The necessary terminals are provided in the form of binding posts on two sides and top of the unit. A 6-foot extension cord and plug is also provided for connection to the 110-volt, 60-cycle supply line. Special units may be obtained from the manufacturer where the line frequency is not the standard 60-cycle supply.

Usage: This unit provides the power foundation unit for a high-voltage "B" power-pack to supply sufficiently high voltage for the operation of a UX-210-type power-amplifier valve and also to supply the filament voltages for this valve and the rectifier valve.

Outstanding features: Takes the place of six of the units ordinarily used in a power-pack which supplies the high voltage as well as the low AC voltage for the filaments of the power-amplifier and rectifier valves. Saves much space and simplifies construction as many of the necessary connections are already within the unit. Neat in appearance. All parts are thoroughly insulated. Terminals are conveniently placed and are plainly marked, thereby eliminating any possibility of making a wrong connection.

Makers: Thordarson Electric Mfg Co.

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This Vernier Dial Is Easy to Install

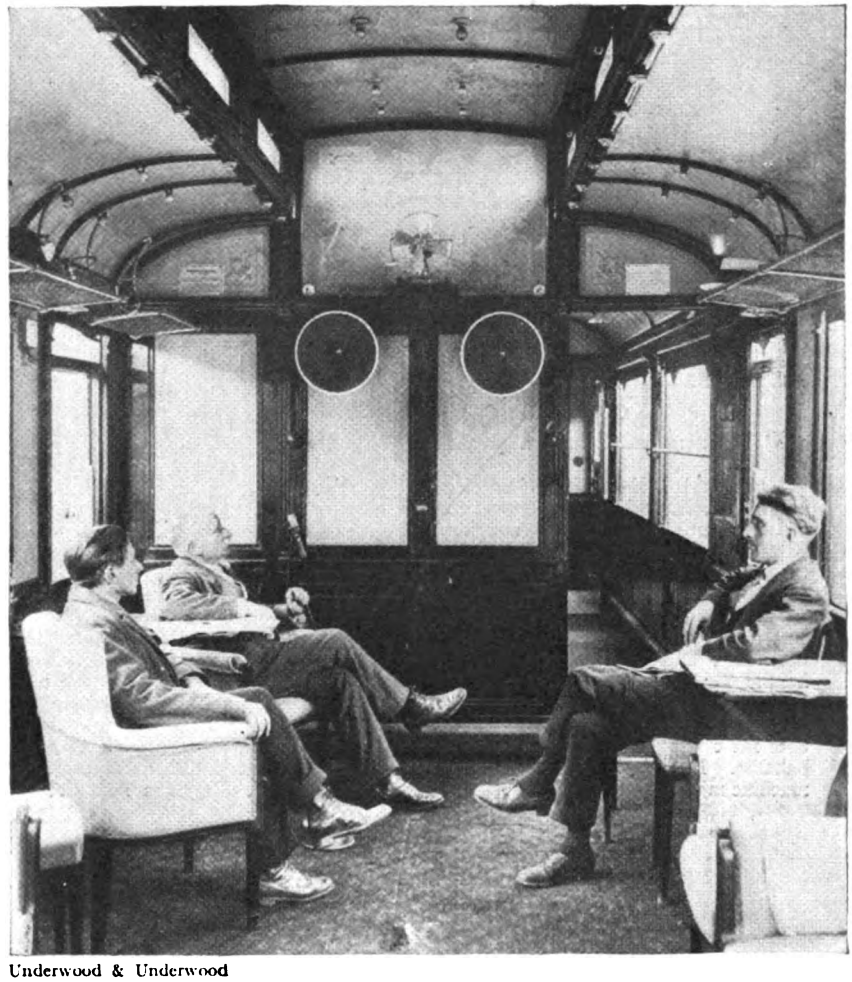
Name of instrument: Vernier dial.

Description: This unit consists of a flat composition dial that may be attached to the shaft of the instrument which it is to control. Over this dial is placed an artistic shield which completely hides the dial, except for a small sector of the calibrated scale which is visible through the indicator window of the composition shield. Mounting of the shield on the panel is accomplished by means of two small holes which must be drilled through the panel to accommodate two screws that are fastened in the back of the shield. The shield is then made fast by nuts placed on these screws from the back of the panel. The control knob is attached to the composition shield and operates a split bushing, which makes contact with the edge of the inner dial and thus provides a mechanical coupling. The coupling has a ratio of approximately 14 to 1.

Usage: As a vernier tuning control for use in conjunction with tuning instruments in a radio receiver.

Outstanding features: Easily installed. Good vernier action. No set-screws used. Neat appearance. Conceals shaft end. May be obtained with several different types of calibration to fit different instruments.

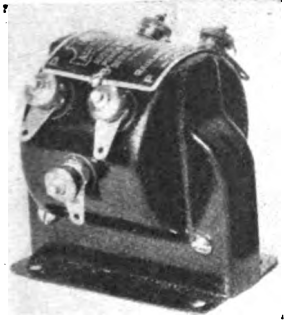
Maker: Kurz-Kasch Co.

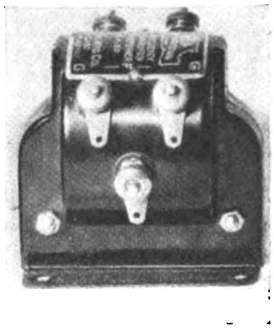


Underwood & Underwood

RADIO ENTERTAINMENT FOR PASSENGERS

The latest addition to the list of radio-equipped passenger trains is the Paris-Orleans express in France; the installation of loudspeakers in the smoking room is shown above. The next step presumably will be the installation of individual receiving sets with headphones at each chair, so that each passenger may enjoy privately the program which he likes most.





Transformers That Supply Large Volume Without Overloading Valves

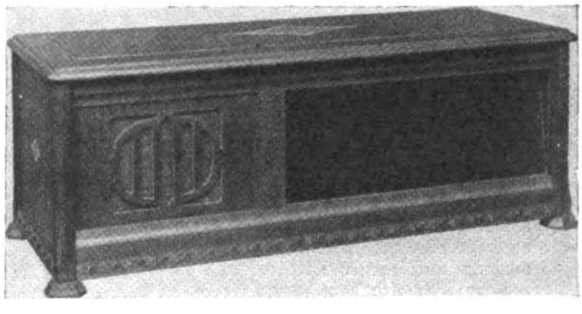
Name of instrument: Power amplifying (push-pull) transformers.

Description: In these transformers the windings and cores are completely enclosed in metal cases with the terminal binding posts mounted on the cases by means of insulating bushings. One winding of each of the transformers is center-tapped to divide the signal voltage between the two vacuum valves used.

Usage: In the last low-frequency amplifying stage of a receiver to prevent overloading by dividing the work to be accomplished in this stage between two valves. Under certain conditions a pair of these transformers in conjunction with two valves may be used as a third transformer-coupled, low-frequency stage to provide great amplification; no more than two stages of this type of amplification can ordinarily be used.

Outstanding features: Neat in appearance. Terminals conveniently located. Helps to prevent overloading in the last low-frequency amplifier stage.

Maker: All-American Mfg. Co.



A New Cabinet for the Home Set Builder

Name of instrument: Radio cabinet.

Description: This cabinet is constructed of solid mahogany in a conservative design; it contains a compartment for the receiving set and a separate compartment at the left end for a reproducer unit. The workmanship is exceptionally good and the finish is all that could be desired.

Usage: As a cabinet for containing radio receiving apparatus.

Outstanding features: Good design. Well finished. Conservative appearance.

Maker: Detroit Woodcraft Corp.

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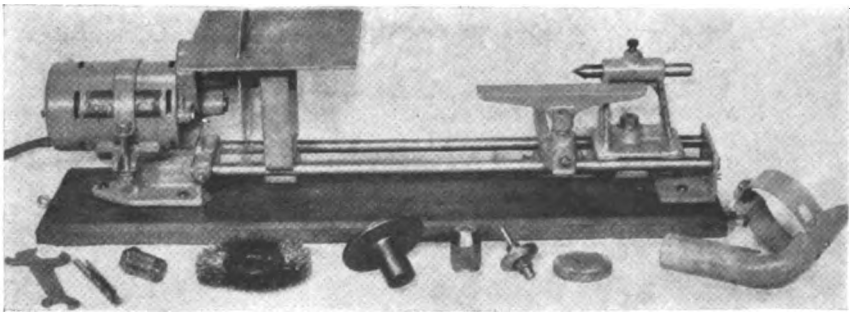


This Machine Tool Will Take the Drudgery Out of Your Radio Construction Work

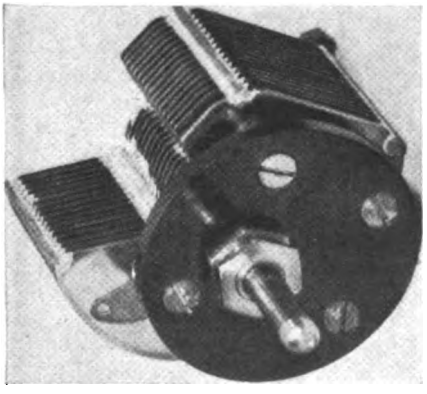
Name of instrument: Combination machine tool.

Description: This tool consists of an electric motor, a wood base, a support for the attachment of various auxiliary parts, and a complete set of machine tools. All of the tools are well made and the combined device is small enough to use in any home workshop. The motor is easily detached from the baseboard and is equipped with a handle for portable use. The outfit is shown above with the circular saw and saw-table attached, ready to be used for cutting wood, hard rubber or bakelite. By simple adjustments the machine may be converted into a lathe, an electric drill, a grinder or a polisher. Numerous other uses will suggest themselves to the experimenter.

Usage: This device provides facilities for cutting and drilling panels, baseboards and cabinets, for cutting and shaping small parts of wood, rubber or composition, and for small lathe-work or grinding and polishing.

Outstanding features: Well constructed of good materials. Good design. Adapted to many uses. Eliminates the tedious manual work involved in radio or other small construction work. Other auxiliary devices are made to go with this foundation unit and motor.

Maker: Electro Magnetic Tool Co.



A Fine Condenser for Use Where Space Is Limited

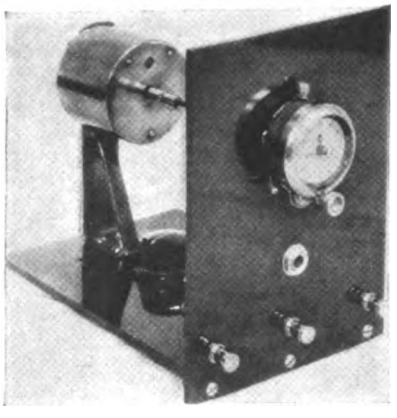
Name of instrument: Variable condenser.

Description: The stator plates are first assembled in a unit by means of slotted rods and solder, which provide rigid spacing and secure suspension. The rotor plates are also assembled in a similar manner and make use of four slotted rods into which the plates are soldered. The stator section is mounted on a round piece of composition insulating material and the bearing for the rotor is also mounted on this same block. The bearing is sufficiently heavy to eliminate the necessity of a second bearing at the rear end of the rotor shaft. A spring contact is provided to the rotor section.

Usage: For any purpose where a variable capacity is required, particularly in the tuned circuits of receivers.

Outstanding features: Extremely small size. Carefully assembled. Rigidly made. Well insulated. Provides an adjustment whereby the maximum capacity may be slightly altered to exactly match the capacity of other condensers, which may be ganged together.

Maker: Armo Radio Laboratories.



An Instrument That Will Automatically Turn a Radio Receiver "On" or "Off"

Name of instrument: Time switch.

Description: This unit consists of a small 8-day clock and a switching mechanism. Provision is made for mounting the clock directly on the panel of a radio receiver while the switching mechanism is mounted behind the panel and is connected to the clock by means of a shaft provided with the instrument. A warning buzzer is also included. The device will start a receiver at any predetermined hour. This is accomplished by setting the clock in the same way that an alarm clock is set; at the specified time the automatic switch closes the "A" battery circuit of the receiver, and, assuming that the receiver has been tuned in advance to the desired station the program will at once be heard. The receiver will continue in operation for one hour, at the end of which time it will be turned off automatically. Or, during that hour the clock may be set to turn the receiver off at any desired time. Thus, if it is desired to hear the dinner music from a certain station beginning at 6 P. M., the clock may be set for this hour at any time during the day. After the receiver has been turned on at 6 o'clock, the clock may be reset for a later hour, and at this time the control switch will automatically turn off the receiver.

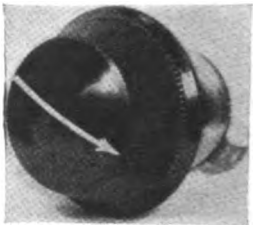
The clock may also be set to ring a warning buzzer at a predetermined hour in case it is desired to tune in some other program at a certain time, or for anything else that requires a reminder at a specified time.

In addition to its use on a radio receiver, the time switch may be used to start a phonograph, to start an electrically controlled furnace and for many other uses, which involve the automatic turning "on" or "off" of electrical current.

Usage: (Covered in the description given above.)

Outstanding features: Makes the operation of a radio receiver semi-automatic. Compact in size (the clock being about the size of an ordinary pocket watch). May be mounted in the receiver or separately. Contains a buzzer warning device.

Maker: Ushichiro Tokumi.



A Switch That Provides a Simple Control of Selectivity

Name of instrument: Antenna switch.

Description: This is a small, single-pole, double-throw switch that may be attached to the panel of a receiver by means of a single-hole mounting. The contact members of the switch are enclosed in a metal shell with a composition back upon which the three terminal connectors are mounted. The space required behind the panel measures 1 inch by ⅞-inch and the unit is equipped with a 1½-inch engraved bakelite knob.

Usage: In a receiver that has two antenna connector terminals (for short and long antennas). This switch may be installed to permit the operator to make an instantaneous change of the antenna from one of these connectors to the other.

Outstanding features: Simple, fool-proof construction. Small size. Positive action. Single-hole mounting.

Maker: Carter Radio Co.

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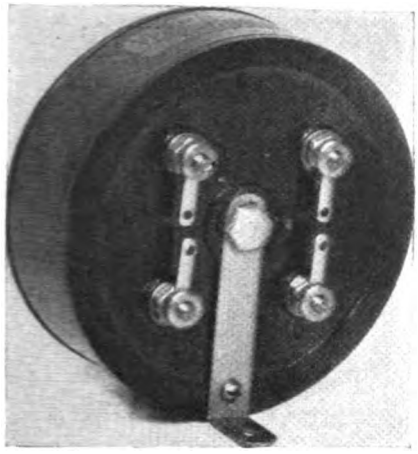


Good Long-Wave Transformers for That New Superheterodyne

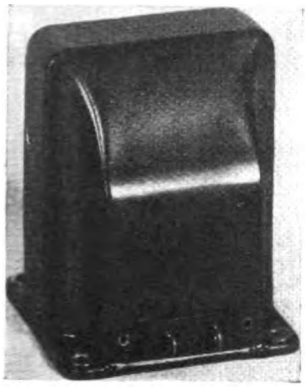
Name of instrument: Victoreen long-wave coupling transformers.

Description: These transformers are of the air-core type and are wound on a 2-inch form. They are of the "fixed tune" type and each transformer is sharply tuned by means of a small semi-variable condenser adjusted and sealed at the factory. The transformers are completely inclosed in round composition cases with the terminals mounted on one side, in a position that makes wiring easy. These terminals are binding posts and are equipped with soldering lugs. Each transformer is supplied with a metal mounting bracket for fastening to the baseboard of a receiver. In addition to the coupling transformers, an antenna coupler and an oscillator coupler are made in the same form to provide a complete kit of couplers for this type of receiver.

Usage: As the coupling units in a superheterodyne receiver.

Outstanding features: Neat in appearance. Sharply tuned and carefully matched. Easy to mount and to wire.

Maker: The George W. Walker Co.



A High-grade, Audio-Frequency Amplifier Coupling Unit

Name of instrument: Dual impedance unit.

Description: This dual impedance is entirely enclosed in a neat metal case with a flanged base, in which are provided the necessary screw holes for mounting the instruments. The four terminals project through the steel case and are mounted on composition insulating strips.

Usage: As a coupling unit in a double-impedance audio-frequency amplifier.

Outstanding features: Rigid construction. Convenient arrangement of terminals. Neat appearance. Compact. Excellent quality of reproduction when used in conjunction with standard vacuum types.

Makers: Samson Electric Co.

A Fixed Condenser That Will Withstand High Voltages

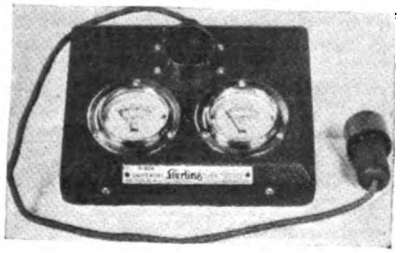
Name of instrument: Filter condenser.

Description: This condenser is hermetically sealed in a metal container to exclude moisture or other elements which might decrease the effectiveness of the unit. The two terminals are brought out at the top of the condenser in the form of soldering lugs. The particular unit pictured herewith has a capacity of 4 microfarads and may be safely used in circuits where the direct-current voltage does not exceed 600 volts or the alternating current, 40 volts.

Usage: As a capacity unit in any circuit where high voltages, either AC or DC are present. Such for instance, as the filter circuit of a power-pack used to supply high voltage for the operation of a UX-210 type tube.

Outstanding features: Compact in size and convenient in form. Carefully assembled. Clearly marked as to capacity and voltage ratings.

Maker: Dubilier Condenser & Radio Corp.



A Device That Makes a Test of Valves

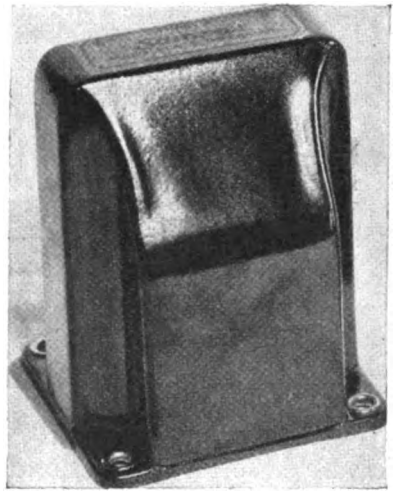
Name of instrument: Tube Tester.

Description: This unit, known as the Sterling R-408 Universal tube tester, is mounted in a metal case, finished in green crackle. The necessary switches, meters and the valve-socket are on the outside of the case. It is equipped with a 2-foot extension cord and a plug. To test a vacuum valve, this plug is inserted in one of the sockets of any receiver which is in operation. The tube which is to be tested is plugged into the socket on the tester. By manipulation of the various switches on the valve tester, in accordance with printed instructions which come with the instrument, the various characteristics of the valve under test may be easily determined. The meters show the filament and plate voltages and also the plate current. One of the most important features of the device is the fact that the plate current reading may be taken with both negative and positive grid biasing. The printed instructions provide all the necessary data to enable the owner of this instrument to properly interpret the readings obtained in the test of any tube.

Usage: To determine the characteristics and quality of any standard three or five-volt vacuum valve.

Outstanding features: Provides all data necessary in determining the characteristics of standard tubes. Operating voltages are obtained by plugging this instrument into a socket of any receiver; thus extra batteries are not required and tests can be made under actual working conditions.

Maker: Sterling Mfg. Co.



An Efficient Unit for the Impedance-Coupled Amplifier

Name of instrument: Low-frequency plate impedance.

Description: This is a well-made unit and is completely inclosed in a black metal case of neat appearance. It has two terminals at one side near the bottom of the instrument. These are in the form of soldering lugs and are mounted on insulated insert in the metal case; mounting holes are provided at the four corners of the flanged base.

Usage: As a plate coupling unit in an impedance-coupled amplifier.

Outstanding features: Adequate inductance. Neat housing. Electrically efficient.

Maker: Samson Electric Co.

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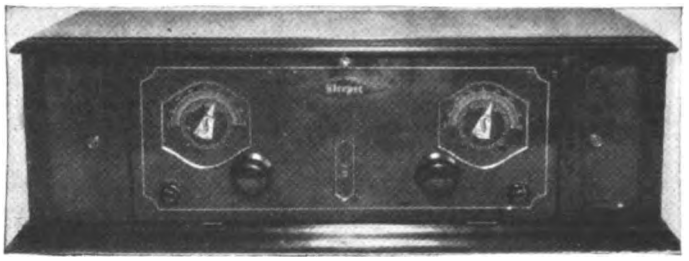


A Moderate-Priced Receiver for Power or Battery Operation

Name of instrument: "Scout" Radio Receiver, type No. 60.

Description: This receiver employs five vacuum valves in two stages of high-frequency amplification, a detector stage and two stages of transformer-coupled, low-frequency amplification.

There are two tuning controls on the front panel; these actuate gold pointers that move over scales engraved directly on the panel. The scales are calibrated in wavelengths. One tuning control operates a dual condenser, which tunes the second high-frequency stage and the detector at the same time; for extremely fine tuning an auxiliary condenser, operated by the lower left-hand knob on the panel, is provided to keep these two circuits in exact balance. The second tuning control operates the condenser which tunes the input or antenna circuit. The filament voltage of all valves is controlled by the rheostat located in the lower, right-hand corner of the panel. The receiver is turned "off and on" by means of a toggle switch located in the lower center of the panel.

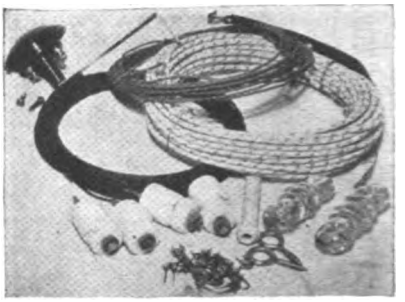
Provision is made for the use of either a UX-201-a, a UX-112 or a UX-171 type valve in the last low-frequency stage. Any desired "B" voltages up to 200 volts may be applied to this stage without harm to the loudspeaker, as an output transformer has been included in the receiver. Provision is also made for the use of either a UX-201-a or a UX-200-a type valve as the detector. Flexible leads are supplied for connections to the batteries; and compartments are provided in the cabinet to accommodate two 45-volt "B" batteries (or a "B" power-pack) and the necessary "C" battery.

The receiver is inclosed in a two-tone walnut cabinet of pleasing appearance and proportions. The panel is of metal but is also finished in two-tone wood graining to match the cabinet. The entire receiver unit is mounted on this panel and is entirely exposed to view by opening the panel outwards. The latter is hinged at the bottom and is provided with a latch at the top to lock it when in the normal closed position.

Usage: For the reception of radio broadcasting.

Outstanding features: Neat appearance. Two-knob control. Easy to operate. Adapted for use of either batteries or power-packs. Equipped for use of power tube. Good volume. Good quality of reproduction.

Maker: Sleeper Radio & Mfg. Corp.



This Kit Contains All Accessories for a First-class Outdoor Antenna

Name of instrument: "Gold Label" antenna kit, No. 270.

Description: This kit consists of 100 feet of hard-drawn, enameled-copper antenna wire; 50 feet of No. 14 rubber-and-cotton covered, lead-in wire; 25 feet of No. 18 cotton-covered, flexible wire; one Underwriter-approved lightning arrester; 2 glass antenna insulators; 4 porcelain lead-in insulators; one 8-inch porcelain lead-in tube; 1 insulated lead-in strip; 2 copper ground clamps, and all other necessary hardware, such as screws, nails, screw-eyes and insulated staples.

Usage: For the installation of a complete antenna-ground system for radio reception.

Outstanding features: Complete, nothing additional to buy. All parts are of first-class material.

Maker: Swan-Haverstick, Inc.

A Valve Tester that Provides a Positive Check on Tube Quality

Name of instrument: Universal valve tester.

Description: This instrument, designated by the manufacturer as "Universal Tube Tester, No. 290," consists of a universal valve socket that will accommodate any valve equipped with a standard base, a milliammeter which serves as a plate-current indicator and a push-button switch. These are mounted in a metal container as illustrated. There is also an extension cord, with a plug on the far end. In checking valves this plug is inserted in the valve socket of the first low-frequency stage of a receiver, thus obtaining the operating voltages direct from the batteries used in operating the receiver and eliminating the necessity for separate batteries and complicated battery connections. To test a valve, the tester is plugged into the receiver socket, as described, and the valve to be tested is inserted in the socket provided in the tester. With the receiver turned on, a reading is taken on the meter which is located on the top surface of the tester. Then another reading is taken with the switch button pushed down. The difference between these two readings indicates the quality of the valve under test. By comparing this difference in readings with the table given in the instructions which accompany the tester, the quality of the valve under test may be determined at once, without any knowledge of radio or mathematics on the part of the user of the instrument.

Usage: To enable the set owner to check his valves to determine their operating qualities.

Outstanding features: Simple to use. Requires no knowledge of vacuum-valve characteristics or theory, on the part of the user. Does not require the use of separate batteries. May be put into operation and a valve may be tested in a fraction of a minute. May be used for testing any valves which employ a standard UX-type base.

Maker: Jefferson Electric Mfg. Co.

A Heavy Rubber Ring that Prevents Microphonic Howling in Vacuum Tubes

Name of instrument: Vibration repressor for vacuum valves.

Description: This repressor is a soft-rubber ring approximately one inch in height and large enough to fit snugly around a standard 5-volt vacuum valve. The rubber has plenty of strength to hold it firmly in position on the valve.

Usage: To be slipped down over the top of any standard UX-201-a type or similar sized vacuum valve, to repress external vibration of the valve and thus eliminate the howls that frequently result when the reproducer is placed too close to a receiver.

Outstanding features: Neat appearance. Installed in an instant. Provides good repressor action.

Maker: Premier Radio Corp.

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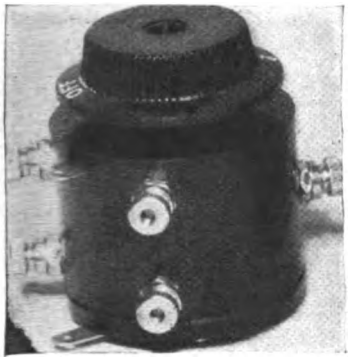


This Unit Replaces Jacks and the Battery Switches

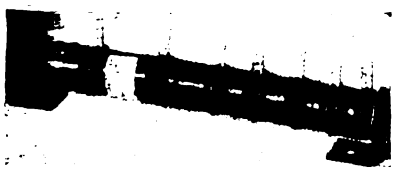
Name of instrument: Multi-stage jack and filament switch.

Description: This unit consists of an insulated case that contains the spring contacts for the switch and jacks with their terminals brought to the outside by means of small binding posts and soldering lugs. It is designed for single-hole, panel mounting and is controlled by a small knob attached to the end of the shaft which projects through the panel. There are three operating positions of this knob. When set at "off" the "A" supply is disconnected from the receiver. When set at position No. 1, the reproducer is automatically connected to the output of the first low-frequency amplifier stage, and the valve filaments of all except the second low-frequency stage are connected to the "A" battery. When set in position No. 2 the reproducer is connected to the output of the second low-frequency stage and the filaments of all valves are lighted. There is a hole through the center of the control knob into which the reproducer or headphones are plugged.

Usage: To combine the battery switch and two filament-control jacks in a single unit in a receiving set.

Outstanding features: Saves panel space. Simplifies wiring of receiver. The reproducer may be connected to either the first or second low-frequency amplifier stages by a single turn of the knob. When the last low-frequency stage is not in use its filament is automatically disconnected from the "A" battery circuit, thus eliminating current waste.

Maker: Rono Manufacturing Co.



This Unit Eliminates the Variable Adjustments in "B" Power-Packs

Name of instrument: "B" and "C" power-pack resistor.

Description: A fixed resistance unit made for the Raytheon type of "B" and "C" power-pack which is tapped at seven points to provide seven different voltage values. The unit is made up of special resistance wire, wound on a tube of material similar to porcelain. The whole unit is covered with a heavy coat of vitreous enamel which is baked on by a heat process. The resistance remains practically constant regardless of the heating effect of heavy currents. The entire resistance unit is mounted on a pair of feet to facilitate attachment to a baseboard, and all terminals are in the form of soldering lugs. The resistance values of the various sections of the unit are clearly stamped on these lugs.

Usage: As the output resistor in any "B" or "C" power-pack where the DC output voltage does not exceed 250 or the current does not exceed 90 milliamperes. The various taps will provide any standard voltages that may be required in the operation of a receiver.

Outstanding features: Excellent materials used. Good, sturdy design. Compact in size. Meets the requirements of any power-pack which uses a gaseous type or a filament type of rectifier valve.

Maker: Ward-Leonard Electric Company.

A Connector That Eliminates Loose Battery Connections

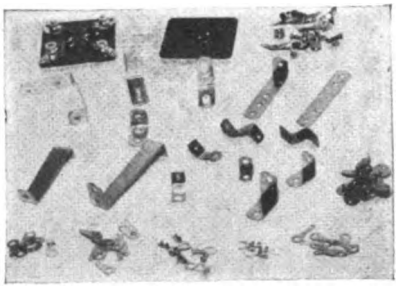
Name of instrument: Battery cable connector.

Description: This connector consists of two parts; one is mounted inside of the receiver by means of a metal bracket that is provided on the instrument. The wires in the receiver that ordinarily lead to the binding posts are then connected to the soldering lug terminals of the connector. The terminals of the other part of the connector are connected to the cable from the batteries. To connect the batteries to the receiver the body of the connector is snapped over the other part. The connections are made within by means of five pairs of spring contacts; these insure good electrical contact. The connector is made of moulded, insulating composition; the contacts are of a metal which provides plenty of "spring" and at the same time makes a good electrical connection.

Usage: For connecting the battery cable to the receiver. It will serve in place of binding posts in the receiver, or it may be installed in a receiver which already is equipped with binding-post terminals.

Outstanding features: Convenient size. Easily mounted and connected. Good insulation. Good contact. Batteries may be instantly disconnected from receiver.

Maker: Beaver Machine & Tool Co., Inc.



Handy Hardware for the Radio Fan

Name of instrument: Radio hardware.

Description: The parts shown in the accompanying illustration should satisfy almost every need for small parts. They consist of metal angles and brackets of numerous shapes and sizes, soldering lugs of various types and UX type valve-prong contacts for use where it is desired to have the valve-prong extend through a sub-panel to make contact underneath. Marker plates are also included. These may be attached to battery wires and terminals and are clearly labeled A—, A+, etc.

Usage: As small hardware for the radio set constructor or experimenter.

Outstanding features: Extensive variety of parts and fittings. Well made. Materials used are admirably adapted to the purpose of the various parts.

Maker: American Radio Hardware Co.

A Compact Condenser Block for Use in Power-Packs

Name of instrument: Power-pack condenser block.

Description: This unit is well constructed and neatly enclosed in a metal container, which is provided with mounting flanges on the bottom and an insulated terminal strip also conveniently located close to the bottom of the instrument. This unit contains five condensers, all that are needed for the filter of a power-pack that makes use of a Raytheon or UX-213 type of rectifier valve. The terminal panel is clearly marked as to the capacity available at the terminals.

Usage: As a complete capacity unit in the filter of a power-pack.

Outstanding features: Easily installed. Compact. Completely enclosed.

Maker: Tobe Deutschmann Co.

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LISTENING IN

PRACTICAL *pointers from experimenters and broadcast listeners. What helpful hints can* YOU *offer to your fellow fan? Readers are invited to address their letters to the Editor of this Department.*

CONDUCTED BY DAVID LAY

A DX Fan in Mid-Atlantic

ON my recent trip across the Atlantic, I had a chance that few fans get—to try radio reception from mid-ocean. Here is the story of my try and the stations I heard.

The R. M. S. *Ascania* left Southampton docks on the afternoon of Saturday, November 6th; as soon as she was under way I set up my receiver, a seven-valve superheterodyne (see Figures 1 and 2), in a state-room on one of the lower decks.

This location, however, proved to be useless using only the loop, owing to the excessive blanketing caused by the steel structure of the ship.

In order to overcome this difficulty, a 20-foot length of wire was weighted and thrown out of the porthole; the near end was wrapped loosely around the loop.

An enormous difference was noticed and a number of European stations were received at full loudspeaker strength using only one of the two low-frequency valves. Stations heard included Bournemouth, London, Cardiff, Newcastle, Dublin, Frankfort-on-Main, Hamburg, Berlin (Voxhaus), Prague and numerous other stations which were not identified.

These stations were heard on Sunday and Monday evening with only slightly diminished volume, although on Monday evening the ship was about 600 miles out.

On Tuesday, November 9th, the instrument was moved to the upper deck. Much better results were then obtained, although, in this case, only the loop was used. The stations mentioned above were received at full loudspeaker strength together with the Leeds, Nottingham and Liverpool relay stations which were duly checked by their call letters. The Spanish stations situated at Barcelona, Madrid and San Sebastian came through when the seventh valve was switched in.

At 3.00 GMT on November 10th the first American transmission began to come through. Two stations were heard at moderate loudspeaker strength using seven valves. These stations proved to be WGY, at Schenectady, N. Y., and WGBS, a 500-watt station in New York City. At this time we were about 1,600 miles from England, just over the half distance.

Later in the day the European stations were again received.

At 22.45 GMT 2LO London was still overloading the reproducer, as also were 2ZY and Madrid (Union Radio).

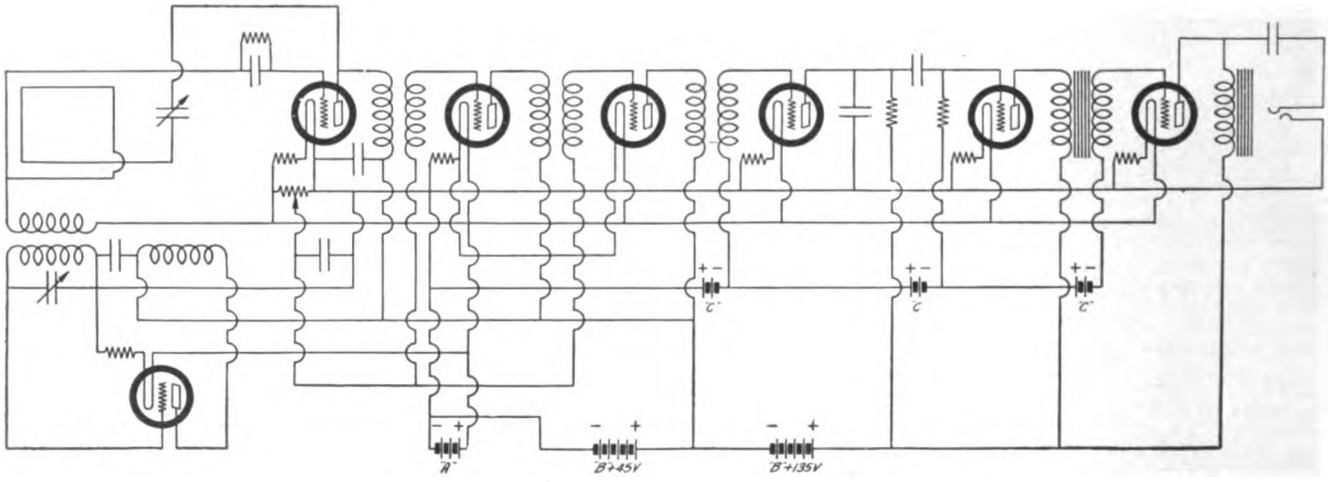
An hour or so later, commencing at 1.10 GMT November 11, the American stations were heard again, but now with enormous volume. WGY, WJZ, WEAF, WBZ and numerous other broadcasters provided the small group of listeners with varied programs.

During the whole day of the 11th transmissions were being received from 2LO (2,000 miles away), 5SC and 2ZY, while the whole of the Peer Gynt Suite was heard from Madrid and a wonderful program was enjoyed from Rome.

On November 12th, 2LO, 6BM, Rome, Madrid and Barcelona were still giving loudspeaker receptions; the usual American transmissions came in later on in the evening together with Canadian stations at Montreal and Moncton, N. B.

The afternoon of November 13th arrived and with it 2LO, 6BM and 2ZY, while later on stations WIOD (Miami Beach, Florida), WBAP (Forth Worth, Texas), CKAC (Montreal), CNRA (Moncton, N. B.) and dozens of stations from New York, Illinois, Georgia, Pennsylvania and Massachusetts.

Came November 14th and we found ourselves off the St. Lawrence Estuary with a 60-mile-an-hour wind and several degrees of frost. On the evening of this day we were able to turn our two dials first to London, then to Madrid, and on to Miami Beach via Rome and Montreal, not by any means an economical



A SENSITIVE SEVEN-TUBE SUPERHETERODYNE CIRCUIT

FIGURE 1: *This is a hook-up of the apparatus used by Mr. Beech for his long distance reception work in Mid-Atlantic.*

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route for ordinary travel, but so very different via Radio!

And so on down the St. Lawrence to Quebec. While waiting here stations at Montreal, New York and Pittsburgh were tuned in with the greatest ease.

As a result of the experiment the following facts may be of interest.

London was received in broad daylight at a distance of 2,400 miles.

The first American transmission came through when about 1,500 miles distant.

At one time WGY Schenectady was heterodyning 2ZY Manchester, Eng., and reception was spoilt from either station.

—J. L. BEECH, *Montreal, Ontario*

* *

How Ordinary Flour Helps Me in Drilling My Panels

IT is sometimes hard to locate the screw holes for condensers and other instruments to be mounted on a panel without the aid of a drilling templet.

Here is a simple way to locate the position for these holes.

Locate and drill the hole for the center shaft of the condenser. Then place the instrument on the panel with the shaft protruding through the hole and rest it in exactly the position you wish it to occupy. Sprinkle a little white powder or flour around the screw bushings and then carefully pick up the condenser without disturbing the panel. The powder will form little circles the centers of which may be marked with a sharp center punch.

—GILBERT D. PRESTON, *El Centro, Cal.*

* *

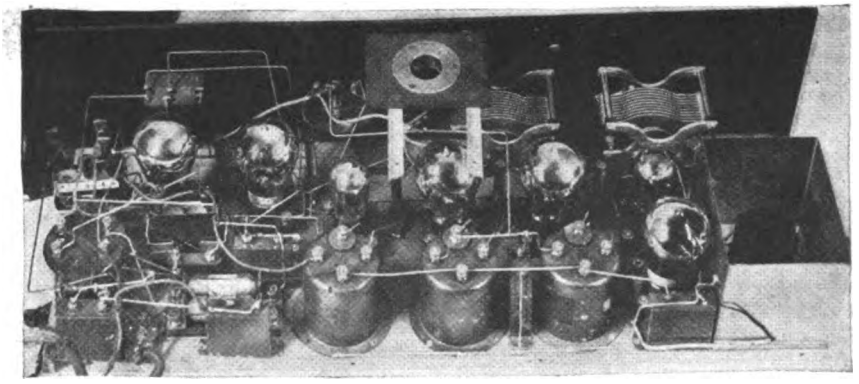
How I Brought My Eight-Tube Cockaday Super Up to Date

I HAVE followed with interest, in some of the recent issues of POPULAR RADIO, descriptions of various changes in the Cockaday superheterodyne reflex receiver.

After nearly two years of satisfactory use of this set I decided that for my use, several changes were necessary. There is no question of the great distance getting abilities of this set, but the reflex principle has a tendency to make it difficult to control at times. Also the resistance coupling did not please me, as it necessitates an extra tube and high "B" voltage. With the Karas transformer and another good transformer in the last stage, just as good results may be secured without these faults.

After considerable thought, I decided that a Tropadyne hookup with transformer-coupled audio would serve my purposes, besides using very few new parts. In fact the only parts needed to make the change were a new oscillator coil (home-made), an .0005 mica condenser, a variable grid-leak, an additional audio transformer and an amperite. The old coil, one socket and the radio transformer in the set were discarded.

It will be noted that this is still the autodyne principle, no separate oscillator being required, and that it reduces the set to seven tubes. On local stations, six tubes provide ample volume. These few changes are all at the extreme left of the set, the right-hand end of the set-up remaining exactly "as is."



REAR VIEW OF THE SET

FIGURE 2: *This picture shows the layout of the set shown in schematic form in Figure 1. The loop is mounted in the socket at the top center of the receiver.*

The amperite I find desirable on the last audio tube, as otherwise, when changing from 6 to 7 tubes or vice versa, the rheostat must be readjusted each time.

Figure 3 shows the new hook-up.

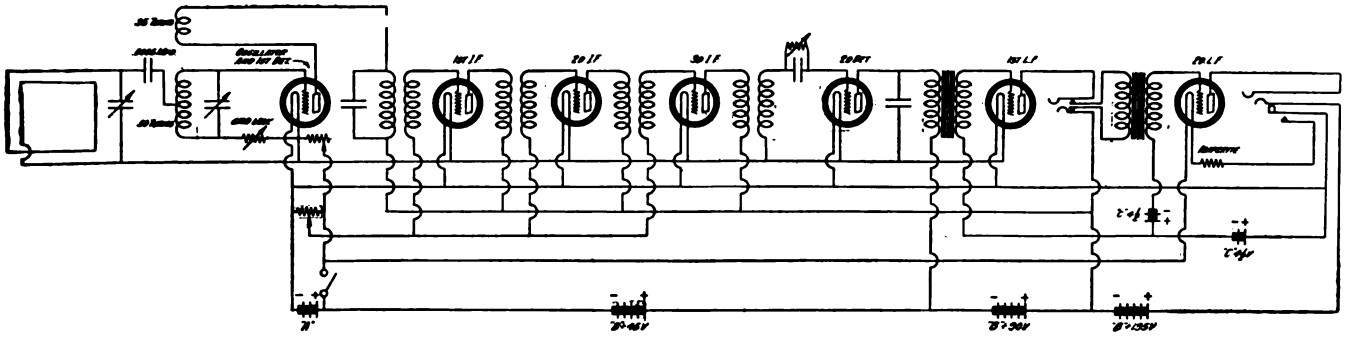
The new oscillator coil is made as follows:

On a 2¾-inch diameter piece of insulating tubing, 3 inches long, wind 50 turns of No. 26 double silk-covered wire, taking a center tap for the grid condenser connection. Leave ¼-inch space; then wind 35 turns more of the same wire for the plate coil. The beginning of the grid coil goes to the grid, and the last turn of the plate coil to the plate of the combined oscillator and first detector tube. The other end of the grid coil goes to the grid-leak (which, by the way, should be set at a very low value), while the other end of the plate coil goes to the plate post on the first intermediate transformer, which is still tuned as before by the small condenser (semi-variable).

The grid condenser (.0005 mfd.) is connected between the center tap and one side of the loop; the two ends of the grid coil are also connected, of course, to the oscillator tuning condenser.

Using this coil, the oscillator con-

(*Continued on page 481*)



A SEVEN-TUBE SUPERHETERODYNE CIRCUIT

FIGURE 3: *This wiring diagram shows how Mr. Bergenstein changed over his eight-tube superheterodyne into a seven-tube affair, eliminating two stages of resistance-coupled amplification and a reflex stage.*

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IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

Are Men Made of Ether Waves?

UNDER the teaching of modern physical theories we have grown accustomed to regard the universe as composed of two essentially different kinds of things. On one side are the electron and the proton, the tiniest particles of matter as well as the ultimate units of electricity. Men and stones, planets and stars, are made, we have been told, out of various assemblages of these two fundamental particles.

On the other side we have what is called radiation or ether waves, from the longest waves of radio down to the shorter waves of light and finally to the shortest waves of all, those of the gamma rays from radium and of the newly-discovered cosmic rays studied by Professor Millikan. Of these two kinds of things—matter and radiation—the modern physicist has been accustomed to build up his picture of the world.

There have been, it is true, some dim spots in this picture. Readers of this Department are already familiar with the puzzles of what is called the "quantum theory"—the theory which considers light and other forms of ether waves as consisting, in some unknown fashion, of small, individual particles and not of waves at all.

For four years theoretical physicists the world over have been seeking for some way of reconciling this theory of ether-wave particles with the more familiar theory of ordinary waves.

Out of this attempt there have emerged in recent months two new ideas concerning the nature of matter and of ether waves; which means two new ideas about the ultimate nature of the universe and of ourselves. It is probably not too much to say that these new ideas are quite as important as the mechanics of Sir Isaac Newton or as the relativity theory of Dr. Einstein. They give us for the first time a rational viewpoint toward the famous Bohr theory of atoms, a theory which we have found it necessary to accept because it fits so many facts, but which the majority of physicists have been frank to say escaped their real understanding.

One of the new viewpoints which the past few months have brought us indicates a still more remarkable conclusion. So far as it can be interpreted in ordinary physical terms at all, it means that everything in the universe, including the bodies with which we study it and the brains with which we attempt to understand it, are composed, not of electrons and of protons, but of ether waves.

The electron (which we have been thanking for the operation of our vacuum tubes) and the proton (which we have been assuming as the stabilizing influence which keeps our atoms from flying apart) are both viewed by this new theory as merely appearances. They are no more than ether waves in a peculiar state, as a whirling dervish in the desert appears to be no longer a man but a revolving dust cloud.

It is perhaps too soon in the development of the new theories to assert dogmatically that this is their physical meaning. Both are essentially mathematical. Their conclusions appear in the form of equations, not as physical pictures. In the explanation of the puzzles of atomic theory, especially of the relations of atoms to light rays, the mathematical findings of the new theories have been reduced to physical terms and tested. They fit perfectly. Further conclusions and applications are being obtained rapidly. For the past two decades the science of physics has been moving so speedily that it seemed impossible to continue at such velocity. Nevertheless, the speed of advance has not only continued but has accelerated.

It is one of the greatest recommendations of the two new theories of waves and electrons that they are entirely different in approach but agree in coming out at much the same conclusions. The first of the two can be dismissed in a

New York Electrical Society

DISPLAYING ONE MYSTERY OF ETHER WAVES

Dr. Norman Hilberry, of New York University, recently illustrated to the New York Electrical Society the beautiful rings and patterns of color produced by reflecting a powerful light beam from a single thickness of the film of a soap-bubble. The existence of these colors is usually believed to be a proof of the wave theory of light; the colors, it is thought, are caused by the interference of two sets of light waves, one reflected from the front surface of the soap film, the other from its rear surface.

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New York Electrical Society

A VISIBLE PROOF OF THE EXISTENCE OF ATOMS

Inside the small, upright apparatus in the center of the picture it is possible to produce visible atom tracks, caused by the atoms which are shot out at enormous velocities from a small bit of radium or other radioactive material. The flying atoms are made to pass through air which is supersaturated with moisture. The passage of each atom causes tiny droplets of this moisture to condense along the path the atom has taken, thus making the track visible.

few words. It is really little more than a new kind of mathematics.

The Bohr theory of the atom, many times described in POPULAR RADIO, assumes that the electrons in atoms have a certain definite number of orbits which they can occupy, and no more than this number. When an electron moves inside an atom it must move from one specified orbit to another specified one. This makes what we call an electron "jump" and this emits light.

Seeking a more suitable mathematical expression for these facts than is supplied by the conventional equations, a German mathematician, Dr. W. Heisenberg, made use of an old but neglected algebraic device, the mathematics of what are called "matrices." Thus he devised what is now called the "matrix mechanics" of atoms and which constitutes the first of the new theories.

Readers who shrink from the no small mental labor which the handling of the matrix mathematics requires must merely take on faith the statement of the experts that the theory fits the facts of atoms better than did the previous, more conventional mathematics.*

The other theory, converging on the same ultimate results as the matrix mechanics of Heisenberg, is the product of Professor E. Schrödinger of the University of Zürich, and is called the "undulatory dynamics" or "wave mechanics."

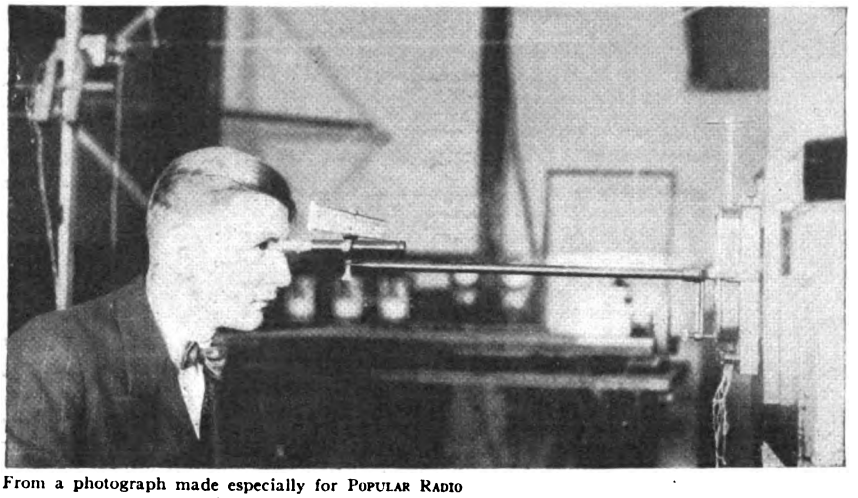
Like the matrix theory it begins with a new mathematical statement of the puzzling facts about ether waves and atoms. The mathematics is, however, very different. It is essentially a mathematical statement suited to the description of waves. Using this on the problems of atoms, which were not supposed to be waves at all, Professor Schrödinger finds that the new wave equations fit quite well; indeed, they fit better than anything else so far. They have been accepted by the majority of mathematical physicists as resolving the most annoying of our former difficulties about waves, atoms and quanta.§

So far as it is now possible to translate the Schrödinger wave mechanics into ordinary physical terms, the meaning seems to be that what we call protons and electrons are merely more or less permanent configurations of waves or wave trains. If you take a stick and touch the surface of the water in a tub you will start a wave across this surface. The wave will be reflected back again when it strikes against the solid side of the tub and by touching the water repeatedly and at the proper intervals you can set up on the surface of the water a reasonably permanent system of waves called "standing waves." Similarly, by shaking one end of a rope such as children use for skipping, the other end being fixed, you can set up a similar system of standing waves on the rope.

(*Continued on page 486*)

*The original papers are: W. Heisenberg, *Zeitschrift für Physik* (Berlin), volume 33, pages 879-893 (1925); M. Born and P. Jordan, *the same*, volume 34, pages 858-888 (1925); Born, Heisenberg and Jordan, *the same*, volume 35, pages 557-615 (1926). None is easy reading and so far as the Editor of this Department is aware the theory has not been "translated" into a language understandable to the average person.

§The original papers, all by Professor Schrödinger, are in the *Annalen der Physik* (Leipzig), volume 79, pages 361-376 (March, 1926); *the same*, volume 79, pages 489-527 (April, 1926); *the same*, volume 80, pages 437-490 (July, 1926). Professor Schrödinger has summarized the chief points of his theory in "An Undulatory Theory of the Mechanics of Atoms and Molecules," *Physical Review* (Minneapolis), volume 28, pages 1049-1070 (December, 1926). There is a brief but clear review of the main implications of both the Schrödinger wave dynamics and the Heisenberg-Born matrix mechanics entitled "Matrix and Wave Mechanics," by R. H. Fowler, in *Nature* (London), volume 119, pages 239-241 (February 12, 1927).



From a photograph made especially for POPULAR RADIO

TESTING THE RESISTANCE OF OXIDIZED COPPER WIRE

Dr. Wesley M. Roberds, of the University of Kansas, has proved that the resistance of a piece of copper wire to high-frequency electric current is not increased materially when the surface of the copper wire is slightly oxidized. Dr. Roberds is shown observing the deflection of a sensitive galvanometer, from the readings of which can be calculated the resistance of the wire.

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★ PROGRAM FEATURES *for* THE MONTH

Here is POPULAR RADIO'S *selection of the "star" broadcast features that are scheduled as regular weekly events for the month beginning April 18—program numbers of outstanding merit that are selected on the basis of intrinsic worth, as well as upon their importance, as determined by the large audiences reached by powerful single stations and by the chain stations that now cover the country. Every radio fan has—or should have—a receiver good enough to tune in on most of the features that are listed.*

(EASTERN STANDARD TIME)

Mondays

ROXY AND HIS GANG; 7.00 P. M.; *110-piece symphony orchestra, with soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WRC, WSB, WHAS, WSM.

Roxy became radio's greatest impresario when, over three years ago, he organized the famous "Capitol Theater Gang," now the Bowes Family. This was the first major musical event to be listed as a regular weekly feature. Roxy began his theatrical career back in 1909 in a small Pennsylvania town, where his brother-in-law operated a saloon. On three evenings of the week Roxy, aided by chairs from the local undertaking establishment, put on moving picture shows in the "back room" of the place. He now manages the largest theater in the world—a theater which embodies dreams he has entertained ever since those Pennsylvania days. Roxy is 43 years old.

RECORD BOYS; 8.00 P. M.; *songs and humor;* WJZ, WBZ.

The Record Boys, who specialize in humorous selections of their own composition, and who have a strong leaning toward humorous negro songs, had a great listening audience long before they came to the air. They made phonograph records for over five years. They have also appeared in vaudeville in the East and Middle West.

HIRE'S HARVESTERS; 8.00 P. M.; *instrumentalists;* WEAF, WEEI, WGR, WLIT, WRC, WCAE, WTAM, KSD, WCCO.
Here the listener will reap a rich harvest of music covering a wide range of interpretation and no monkey business.

WILLYS-OVERLAND SYMPHONY; 8.30 P. M.; *symphonic music and soloists;* WJZ.
Henry Hadley with a miniature symphony made up from the membership of the New York Philharmonic Orchestra.

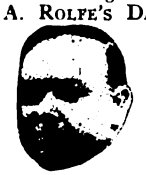
A. AND P. GYPSIES; 9.00 P. M.; *classical and semi-classical music;* WEAF, WEEI, WJAR, WDAF, WRC, WCSH, WTAM, WLIT, WWJ, WCAE, WSAI.
Chain-store music popular enough to hold the attention and merit the applause from one of the biggest chains of stations used in the business. The regular soloist is John Barnes Wells, one of the best of the lyric tenors—who is also a composer.

WBAL ENSEMBLE; 9.00 P. M.; *chamber music;* WBAL.

RUUD LIGHT OPERA; 9.30 P. M.; *orchestra and soloists;* WJZ, KDKA, WBZ.
Light opera molded into proper shape for air use.

LIDO VENICE DANCE ORCHESTRA; 10.00 P. M.; *jazz music;* WEEI.
New England's finest source of dance music.

B. A. ROLFE'S DANCE ORCHESTRA; 11.00 P. M.; *jazz numbers;* WEAF.



B. A. Rolfe is one of the very few men who is able to reach and carry melody in the super-treble scale of the cornet. He has had three cornets stolen by musicians who have thought that he employed some trick or device to obtain this effect!

WBAL DANCE ORCHESTRA; 11.00 P. M.; *dance music;* WBAL.
Smart music from Baltimore's best.

CORNADA ORCHESTRA; 1.00 A. M.; *dance music;* KMOX.
St. Louis' 99 per cent. contribution to the jazz industry.

Tuesdays

DINNER CONCERT; 6.30 P. M.; *classical and semi-classical music;* WGY.
Direct from the Hotel Ten Eyck at Albany for those who cannot tap the early music of the New York stations.

WBAL DINNER MUSIC; 6.30 P. M.; *chamber music;* WBAL.
Easily available to those New Yorkers who cast about for good dinner music and cannot find it.

GEORGE OLSEN'S STROMBERG-CARLSON ORCHESTRA; 8.00 P. M.; *dance music;* WJZ, WBZ, KDKA, KYW.

George Olsen tries hard to set the standard for American dance music and he comes within the deuce of spades of doing it. He used to broadcast from the grill room of the Pennsylvania Hotel in New York, but now he holds forth in the WJZ studio for the Stromberg-Carlson Company.

EDISON ENSEMBLE; 8.00 P. M.; *classic and popular music;* WRNY.
What the New York Edison Company is doing for broadcasting. This hour is carefully planned and well managed by Charles Isaacson. The Edison company states that radio has increased its business over $1,000,000 a year.

CHAMPION SPARKERS; 8.30 P. M.; *popular music;* WJZ, KDKA, KYW, WBZ.
Sparkling music with a strong appeal to those with a temperament not attuned to the heavy stuff.

GRAND OPERA PROGRAM; 9.00 P. M.; *soloists and instrumentalists;* WJZ, KDKA, KYW.
Grand opera by a special company. Excerpts from the more popular operas are usually played.

EVEREADY HOUR; 9.00 P. M.; *varied program;* WEAF, WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI, WTAG, WRC, WGY, WHAS, WSM, WSB, WMC.

This feature, which takes its place among the best ten, has its own company of regular performers, which is usually augmented by the appearance of star attractions, ranging from Pablo Casals to Irvin Cobb. Virginia Rea is the coloratura soprano of the club; she is one of the few of the regular sopranos who has had the advantage of European voice training.

EDUCATIONAL PROGRAM; 9.00 P. M.; *lectures;* WLWL.
An educational program involving a wide range of subjects and delivered by men who know them well. WLWL's program is something in the nature of a forum for the discussion of the country's social, political and economical problems of the day. It is run by the Paulist Fathers.

JUBILEE SINGERS; 9.00 P. M.; *female quartet;* WBAL.
Female quartets are hard to find, and usually, when found, hard to listen to. Here's a good one to try on your radio.

MUNICIPAL BAND; 10.00 P. M.; *Baltimore City Band;* WBAL.
The pride of Baltimore in an hour of real band music.

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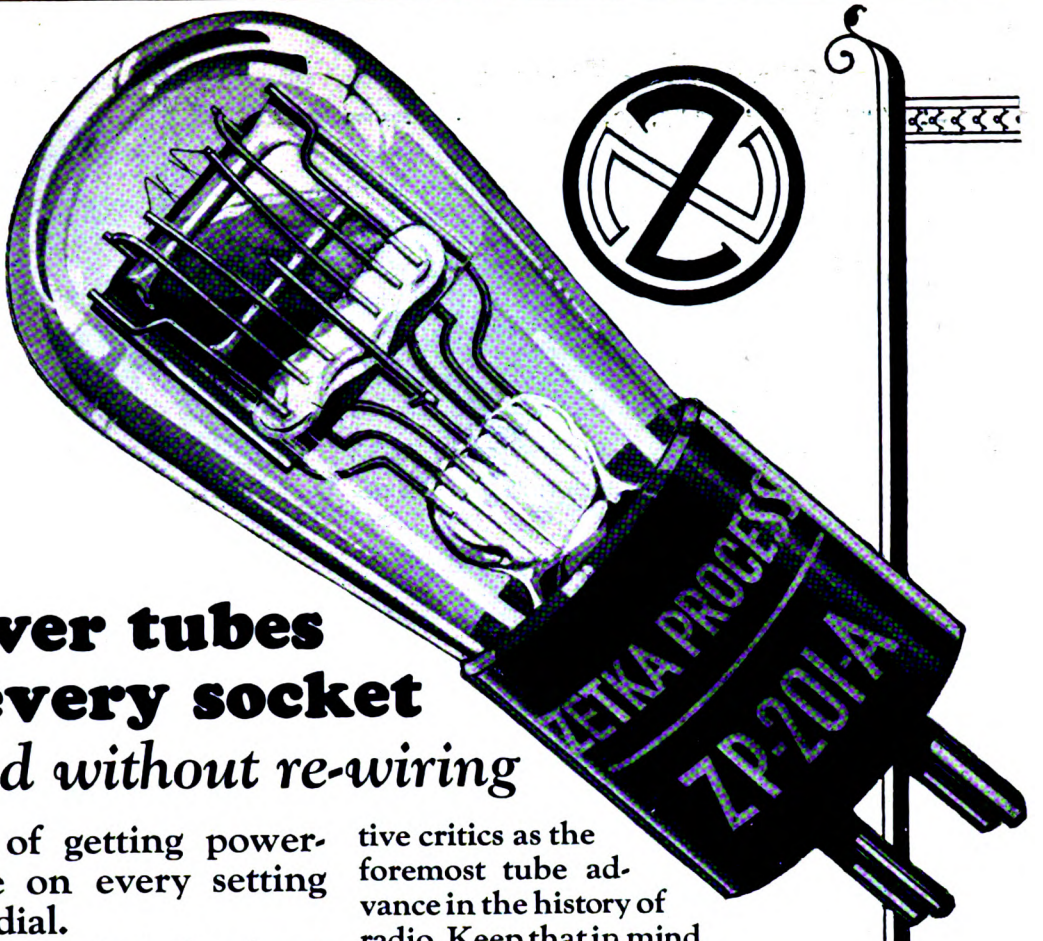

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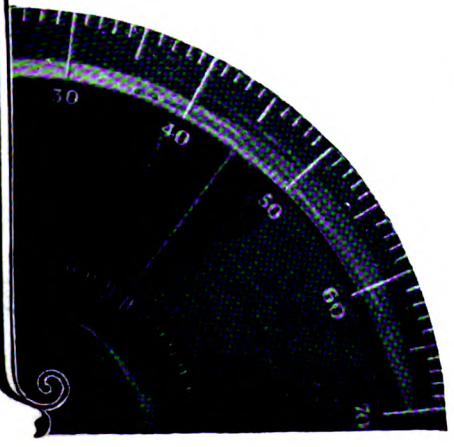

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SAM 'N' HENRY; 9.00 P. M.; *negro comedy;* WGN.
Negro stories and songs by a couple of funny men who have made many records for the large phonograph manufacturers. If you are a phonograph fan, you know 'em.

BRIDGE INSTRUCTION; 10.00 P. M.; WEAF, WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO, KSD, WRC, WGY.
Don't cross your bridge instruction until you tune in for this one—providing you are a bridge player. And who isn't?

DON AMAIZO; 10.00 P. M.; *violinist;* WJZ, KDKA, KYW.

Godfrey Ludlow, the Australian violinist, and the romantic "Don Amaizo," were found and established at WJZ by David Sarnoff, the Vice-President and General Manager of the Radio Corporation of America. Mr. Sarnoff happened to hear Ludlow play at a private concert. Mr. Ludlow now participates in many programs at WJZ'S "Armchair Hour"—a feature he originated.

ARROWHEAD INN ORCHESTRA; 10.30 P. M.; *dance music;* WGBS, WIP.
Snappy music from a snappy road house at the gateway to New York's "Great White Way."

Wednesdays

DINNER CONCERT; 6.45 P. M.; *chamber music;* WSM.
A delightful hour of Southern melodies and chamber music from Nashville's "bestest" hotel.

RADIO NATURE LEAGUE; 7.30 P. M.; *nature talks;* WBZ.

Thornton Burgess, the director of the Radio Nature League, conducts this edifying hour of nature talks. "To do everything possible to preserve and conserve all desirable American wild-life, including birds, animals, flowers, trees and other living things," is the way in which Mr. Burgess phrases the reason for the existence of the league, which has been organized since January 27, 1925. Mr. Burgess' cordial "Good evening, neighbors," is anticipated by every nature lover within the range of WBZ's waves.

KATZ AND HIS KITTENS; 8.00 P. M.; *dance orchestra;* WQJ.
Katz and His Kittens play through WQJ after having completed a year's contract with the management of the Million Dollar Pier of Atlantic City. This is one of the ten best orchestras in the United States.

IODENT'S NO. 1 AND NO. 2; 8.30 P. M.; *the Mitchel Brothers, banjo and piano;* WJZ, WBZ, KDKA, KYW.

The Mitchel Brothers, crooning banjoists and songsters of the Iodent half-hour, hail from the homeland of their craft, Tennessee. Last year these chaps, who are barely out of their teens, were quite unknown. Radio found them and exposed their musical wares to what later proved to be a very appreciative audience. Naturally, Tennessee banjoists sing plenty of darky songs.

DAVIS SAXOPHONE OCTETTE; 8.30 P. M.; *popular and classic music;* WEAF, WEEI, WJAR, WLIT, WRC, WCAE, WTAM, WSAI, WCSH.
This group is perhaps the only musical organization in the United States that uses only saxophones, all in different keys. Although the saxophone has never been admitted to the circle of formal music, this octette offers unique and particularly entertaining popular selections.

STEINDAL STRING QUARTET; 8.30 P. M.; *semi-classical music;* KMOX.
Good music from a quartet that has held its own place on the KMOX program for the past year.

REMINGTON BAND; 8.30 P. M.; *typical band selections;* WGY.

Edwin L. Daniels, conductor of the Remington Band, has recruited his players from the employees of the Remington Arms Co., of Olean, N. Y. This program is made possible by remote control pick-up direct from the Remington factory. The response from the WGY audience has been so favorable that this band concert feature is being continued indefinitely.

IPANA TROUBADOURS; 9.00 P. M.; *dance music;* WEAF, WEEI, WGR, WRC, WCAE, WWJ, WLIB, KSD, WCCO, WDAF, WGY.

The Ipana Troubadours became instantly popular with those who really appreciated good dance music at their first appearance. Most of the members of this orchestra played in big-time vaudeville before going into the toothpaste business.

MAXWELL HOUR; 9.00 P. M.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW, WHAS, WSB, WMC, WSM.
That this feature is "good to the last note" is testified to by the large number of stations. Well worth tuning in on.

RCA RADIOTRONS; 10.00 P. M.; *songs and comedy;* WJZ, WBZ, KDKA, WEBH.
A variety hour with occasional surprises, largely vocal. But its audience has grown accustomed to novelties of all sorts! A good variety program supplied by animated vacuum tubes with the proper grid bias and plate voltage.

FISHER'S DANCE ORCHESTRA; 10.00 P. M.; *dance music;* KFI.
Dance music with Harry Fisher, one of California's greatest orchestra leaders, wielding the baton.

SMITH BROTHERS; 10.00 P. M.; *humorous songs;* WEAF, WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO, WDAF.

The famous "Mark" and "Trade" of cough-drop fame are represented by two young men who formerly led the musical activities at Rutgers College. They fill this period with humorous songs and instrumental numbers.

HAGAN'S DANCE ORCHESTRA; 11.00 P. M.; *dance program;* WOR.
Cass Hagan is the young owner and leader of this orchestra; he is a newcomer to the air. Mr. Hagan is the son of a New York politician.

JADE ROOM DANCE ORCHESTRA; 11.00 P. M.; *dance music;* WTAM.
Good dance music from a green room. (This, incidentally, is Cleveland's one dependable source of one-steps.)

KFI MIDNIGHT FROLIC; 3.00 A. M.; *varied program;* KFI.
This is not only a remarkably good musical event, but it also stands as a target for the long-distance radio shooters of the East.

Thursdays

PALAIS ROYAL ORCHESTRA; 6.00 P. M.; *dance music;* WEEI.
Like a Boston edition of Rolfe's famous Palais d'Or orchestra.

MEYER DAVIS ORCHESTRA; 7.00 P. M.; *dance music;* WGBS.

ORGAN RECITAL (Fred Weaver); 7.30 P. M.; *classical and semi-classical selections;* WBAL.
Fred Weaver is a graduate of the famous Peabody Conservatory of Music, where he now plays the organ for the WBAL audience. Mr. Weaver rarely plays light numbers, but holds rather to the selections that have been written for the organ.

CONCERT ENSEMBLE; 7.35 P. M.; *chamber music;* WGN.
One of a precious few really good chamber-music hours from a town noted for its radio jazz.

CHATEAU SOURIER CONCERT; 7.45 P. M.; *chamber music;* CNRM.
This concert comes from the famous Chateau Sourier Hotel in Montreal. The ensemble is one of the most-listened-to musical organizations on the Canadian air.

WBAL ENSEMBLE; 7.45 P. M.; *chamber music;* WBAL.

Here is a quiet, dignified ensemble that is deservedly popular with the listeners. It is made up of strings and wood-winds. Robert Jula is the young conductor of this ensemble; here is his portrait.

CLICQUOT CLUB ESKIMOS; 9.00 P. M.; *banjo ensemble;* WEAF, WEEI, WCCO, WGN, WCAE, WGY, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ.

The Eskimos play all of the light music worth playing—and they play mighty well. They have a tremendous following. Harry Resor, the "chief Eskimo," is pictured here at the left.

FULLER ORCHESTRA; 9.30 P. M.; *popular music;* WGHP.
Something more than "just another dance orchestra."

GOODRICH SILVERTONE QUARTET AND ORCHESTRA; 10.00 P. M.; *popular music;* WEAF, WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WSAI, WCSH, WADC, WHAS, WSB, WSM, WMC.
Smart dance music on the threshold of the dance period. This orchestra has been popular with the WEAF audience for nearly two years. Vocal soloists are usually used.

MUSIC BOX HOUR; 11.00 P. M.; *varied program;* KFI.

Virginia Fhahri, one of KFI's standard features, is both a mandolin player and also one of the best sopranos in the West. Her constant companion is a trained parrot, who sits at the end of the mandolin while she entertains the KFI audience.

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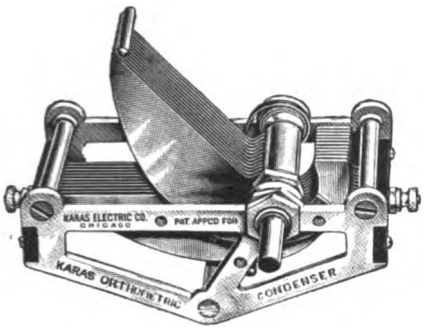

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Fridays

HOTEL BRETTON HALL ORCHESTRA; 6.30 P. M.; *chamber music;* WOR.
This ensemble from WOR offers a dignified and well-chosen program of classics and semi-classics. It is a seven-piece organization made up of strings and wood-winds.

KING EDWARD HOTEL ORCHESTRA; 6.35 P. M.; *chamber music;* CNRT Hotel.
This orchestra, playing in the main dining-room of Toronto's smartest hotel, is under the direction of the well-known Canadian director, Luigni Romanelli. The concert is immediately followed by the Apollo Male Quartet—another popular CNRT feature.

MIXED QUARTET; 7.30 P. M.; *male voices;* WBAL.
Male voices singing old ballads. This is really an old-fashioned quartet in its ideas, but its execution is good.

HAPPINESS BOYS; 7.30 P. M.; *songs and jokes;* WEAF.

An old vaudeville team bursting with new songs and new jokes. This is one of the best light features on the air. Billy Jones, the tenor, and Ernest Hare, the baritone, write many of their own numbers. One reason why they give such enjoyment is because they get so much fun themselves.

GOLDMAN BAND; 8.00 P. M.; *wide range of selections;* WEAF, WEEI, WGR, WLIT, WRC, WCAE, WTAM, WWJ, WSAI, WOC, WCCO, WGY, KVOO, WFAA, WOAF, WLIB.

Edwin Franko Goldman, leader of the now famous Goldman Band, has been called the greatest bandmaster of the day; he is also a composer of standing. For ten years he was connected with the Metropolitan Opera House, and while there he wrote several selections. "Chimes of Liberty," "Sagamore" and "On the Farm" are among his best efforts. While playing on the campus of the New York University two summers ago, Mr. Goldman was inspired to write two band selections, one entitled "On the Campus" and another "On the Air."

MARKEL'S SOCIETY ORCHESTRA; 8.00 P. M.; *dance music;* WJZ, WBZ, KDKA, KYW.
Markel's Society Orchestra means just that; it plays for a great many of New York society's smartest functions.

ROYAL HOUR; 8.30 P. M.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW.
This invariably features well-known soloists and instrumentalists. The orchestra confines its interpretations to the standard classical works.

TRAYMORE CONCERT ORCHESTRA; 9.00 P. M.; *chamber music;* WPG.
The same music used by a great Atlantic City hotel to entertain its guests.

LA FRANCE ORCHESTRA; 9.30 P. M.; *popular orchestral music;* WEAF, WGR, WLIT, WOC, WCAE, WTAM, WWJ, KSD, WDAF, WMAG.

This orchestra is under the direction of a woman, Miss Anne C. Byrne, who has been engaged in orchestral work for the last ten years. Many of the arrangements she plays are strikingly delightful and the La France Orchestra has been a favorite with real music-lovers for several years. The leader herself uses the piano.

ARMCHAIR HOUR; 10.00 P. M.; *vocal and instrumental music;* WJZ, WBZ.

Milton Cross has become part and parcel of WJZ's environment, for he is not only announcer, but a tenor soloist. Mr. Cross joined WJZ's staff in 1922 and is one of the most popular announcers in the country, due to his splendid announcing for operas and the most formal of the musical features presented by WJZ. Cross has been known to have spent twenty hours in research at the New York Public Library that he might have a complete story of an opera to give to the radio audience. This man is responsible for the dissemination of more musical knowledge by radio than any other announcer on the air.

WHITTAL ANGLO-PERSIANS ORCHESTRA; 10.00 P. M.; *classical and semi-classical music;* WEAF, WEEI, WJAR, WTAG, WGR, WLIT, WTAM, WCAE, WWJ, WCCO, WDAF, KSD, WOC, WGN, WGY.

Variety is the keynote of the Whittal Anglo-Persians' musical program for Friday evenings. From "The Call of the Desert" to the parting melody, each number is so entertainingly different from the others that, no matter what your taste in music may be, you will find somewhere in this program a number which will strike your fancy and mood. A romantic Oriental melody, a familiar waltz, a musical comedy, an intermezzo, and a Gypsy air, all are offered. It is easy, therefore, to see that Director Louis Katzman's offerings are delighting listeners wherever radio is enjoyed.

DANCE ORCHESTRA; 11.00 P. M.; *dance music;* KDKA.

Saturdays

JACQUES RENARD'S ORCHESTRA; 6.45 P. M.; *dance music;* WEEI.
This and the orchestra at the Palais Royal supply Boston with practically all of its really good dance music.

ARCADIA BALL ROOM ORCHESTRA; 7.45 P. M.; *dance music;* WGBS.
One of the good New York dance orchestras in what is always a corking fine hour of dance music.

BENJAMIN FRANKLIN ORCHESTRA; 9.30 P. M.; *chamber music;* WIP.
A famous Philadelphia hotel permits the whole radio world to listen to music supplied to its diners.

HOTEL CHELSEA CONCERT; 9.30 P. M.; WPG.
All strings and wood-winds, with a leader who knows how to choose a good program.

"OUR GOVERNMENT"; 10.00 P. M.; *talk by David Lawrence;* WEAF, WTAG, WGR, WFI, WRC, WCSH, WGY.
David Lawrence is a widely read observer of political and economical conditions, both national and international. His contributions to war literature made him famous.

ARCADIA DANCE ORCHESTRA; 12.00 P. M.; *dance music;* KMOX.
If the Middle West should put in a bid for the dance music championship, this orchestra would be one of the entries.

COLORADO ORCHESTRA; 12.30 P. M.; *dance music;* KOA.
Sparkling jazz from the "mile-high" broadcaster of the wide open spaces.

Sundays

BEDFORD Y.M.C.A. MEN'S CONFERENCE; 4.00 P. M.; *Dr. S. Parkes Cadman;* WEAF, WEEI, WCSH, WTAG, WCAE, WSAI.

Dr. Cadman is perhaps better known to the public than any churchman in America—and his fame began with the broadcasting of his sermons, which led directly to the syndicating of writings to the newspapers at an income said to be considerably more than President Coolidge's.

CROSLEY RADIO FEATURE (alternate weeks); 5.30 P. M.; *varied program;* WEAF, WEEI, WJAR, WTAG, WGN, WFI, WRC, WCSH, WCAE, WTAM, WWJ, WSAI, KSD, WDAF, WHAS, WSM, WSB, WMC, WGY.
A newcomer with plenty of snap and good musical novelties.

PARK V. HOGAN ORGAN RECITAL; 7.00 P. M.; *organ and vocal;* WJZ.
This recital is given on an Estey organ by an organist who has been entertaining the New York audience with organ music for the past four years.

THE CAPITOL GRAND ORCHESTRA (and Major Bowes' family); 7.20 P. M.; *symphonic music and soloists;* WEAF, WEEI, KSD, WRC, WWJ, WJAR, WCAE, WTAG, WHAS, WSB, WSM, WMC.

Since she was ten years old, Caroline Andrews, often called the "lark" of Major Bowes' family, has been singing before audiences. Her mother was an opera singer, and Caroline, at the age of five, used to use her mother's trunk for a stage in singing operatic selections that she had memorized through the effort of her parent. Miss Andrews sung with the De Koven Opera Company, the Philadelphia Opera Company, the St. Louis Opera Company and lately in "The Student Prince."

DELLA ROBBIA CONCERT; 7.45 P. M.; *chamber music and solos;* WOR.
Great relief on a day filled with hymns and sermons.

COOK'S TOURS; 8.30 P. M.; *travelogue with music;* WJZ.
Travelogues with musical garnish in the form of folk numbers from the countries visited.

AMBASSADOR CONCERT; 9.10 P. M.; *chamber music;* WPG.
Pleasant chamber music out of Atlantic City's salt air.

ATWATER KENT HOUR; 9.15 P. M.; *star soloists;* WEAF, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ, KSD, WRC, WSAI, WGY, WHAS, WSB, WMC.

This "highest-priced radio program in the world" features so many great vocal and instrumental stars that few listeners stop to give a thought to the leader of the orchestra that supplies such perfect accompaniment. This important work is done by a very young man in the musical world; his name is Niccolai Berezowsky, and he is not only a capable orchestra director, but he takes his position among a small group of "very-near-great" violinists. He was educated musically in Russia and Germany. Paul Althouse, the Metropolitan tenor, is the guest artist April 24th.

COLLIER HOUR; 9.30 P. M.; *variety program;* WJZ, KYW, WBZ, KDKA.
This is a new idea in broadcasting; it is usually attended by famous writers of fiction and fact and some good music worked into a splendid scheme for continuity.

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PERFECT FIXED RESISTOR
This package contains
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Please send me data on Bradleyunits and your folder on B-eliminator hook-ups.

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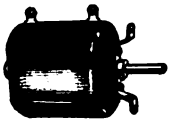
depends primarily upon two things—an efficient circuit and use of GOOD PARTS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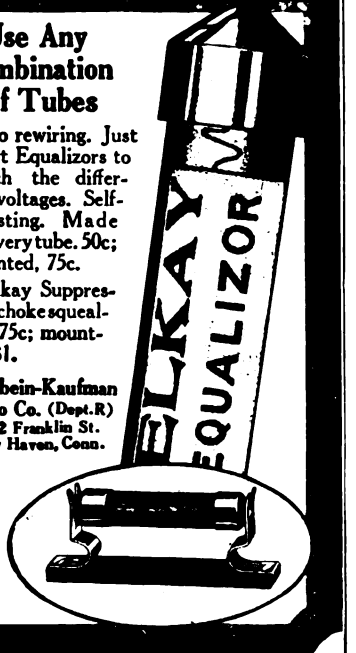

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Simply adapt to your set with

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The use of a Power Tube in the last audio will very greatly improve your tone quality. No change in set wiring is necessary when Connectoralds are used.

For UX 171 and UX 112 Tubes, Na-Ald 112 Connectoralds are recommended for maximum volume with storage battery sets. These tubes will deliver without distortion several times the volume of the regular 201A. Price $1.50.

For UX 120 Tubes in UV 201A sockets, the Na-Ald No. 120 Connectorald should be used. To convert a storage battery set to dry batteries with ample loud speaker volume, use a UX 120 tube in the last audio stage with the 120 Connectorald and UX 199 tubes with 419X Adapters in the other sockets. Price $1.25.

For the UX 120 Tube in UV 199 sockets, ample loud speaker volume without distortion is obtainable from any set equipped for UV 199 tubes by means of the UX 120 or equivalent tube, with the Na-Ald No. 920 Connectorald. The tube is raised slightly, but provides for its use in most sets with limited headroom. Price $1.25.

For UX 120 tubes in the UV 199 sockets of the Radiola Superheterodyne Semi-Portable and Radiola Super VIII. These excellent Superheterodynes will deliver ample volume for loud speaker operation when equipped with the UX 120 used with the Na-Ald No. 420 Connectorald. Price $1.25.

ALDEN MANUFACTURING CO.
Dept. 322-C Springfield, Mass.

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Schedules of Dinner-Hour and Dance Programs of Special Note

★ Programs of Dinner-Hour Music

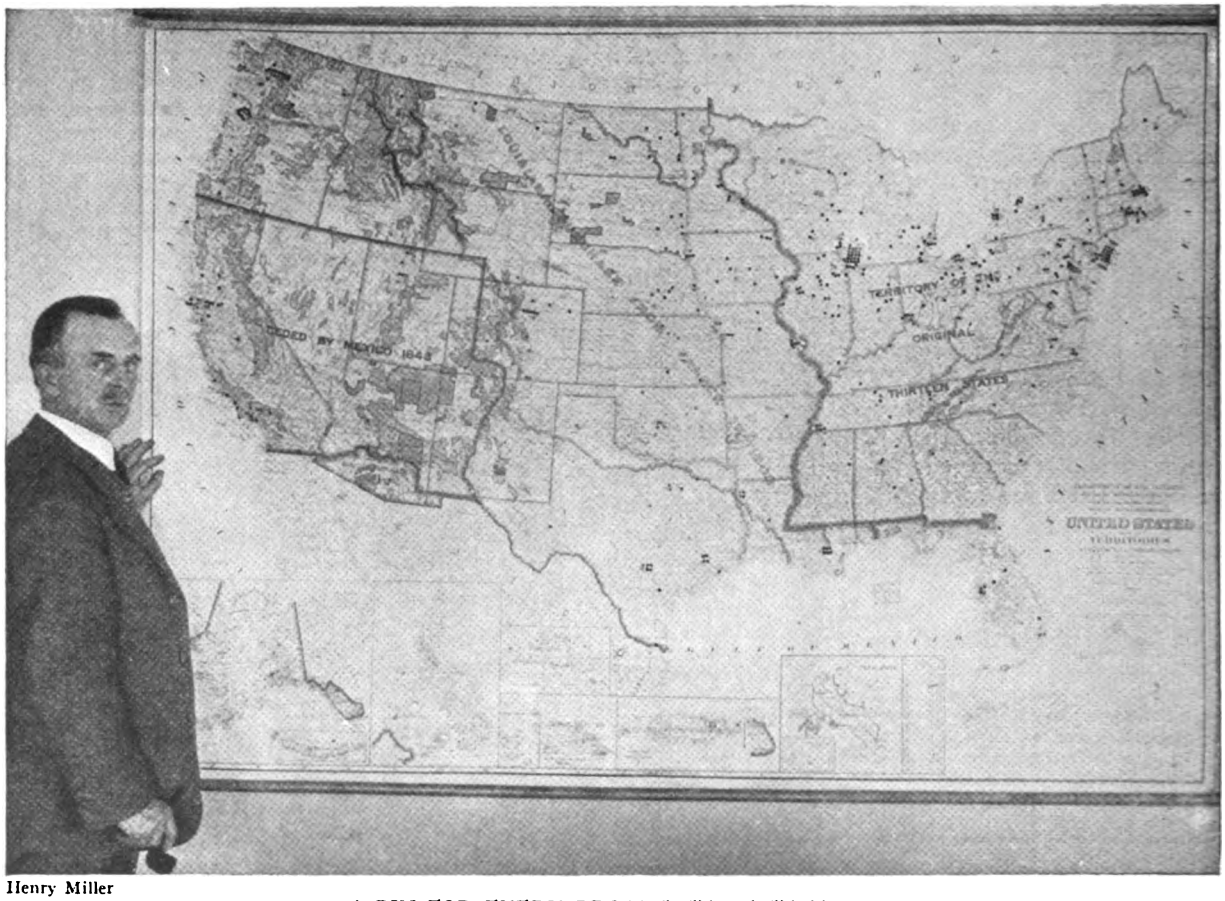
(Eastern Standard Time)

FEATURE	STATION	TIME
Palmer House Victorians	WEBH	7:15 P. M.; *daily except Sundays.*
Hotel Andrew Jackson Concert	WSM	7:15 P. M.; *Tuesdays;* 6:45 P. M.; *Wednesdays and Thursdays.*
Neopolitans	WTAM	6:00 P. M.; *Wednesdays and Thursdays.*
Austin Wylie's Orchestra	WTAM	6:00 P. M.; *Fridays.*
Bem's Little Symphony	KGO	9:00 P. M.; *daily except Saturdays.*
Kats and His Kittens	WQJ	8:00 P. M.; *daily except Sundays and Mondays.*
Hotel Tuller Concert	WGHP	7:00 P. M.; *daily except Sundays.*
WBAL Dinner Concert	WBAL	6:30 P. M.; *Mondays, Tuesdays, Thursdays and Fridays.*
Joe Rine's Orchestra	WEEI	6:05 P. M.; *Mondays, Wednesdays and Thursdays.*
Jack Renard's Orchestra	WEEI	6:45 P. M.; *Saturdays.*
Mack's Collegians	KFI	9:30 P. M.; *Saturdays.*
Ray Fisher's Orchestra	KFI	10:00 P. M.; *Wednesdays.*
Concerts from Atlantic City Hotels	WPG	7:25 P. M.; *daily except Sundays.*
Special Dinner Programs	WBZ	7:00 P. M.; *daily.*
KDKA Little Symphony	KDKA	6:00 P. M.; *Tuesdays, Thursdays.*
Coronado Orchestra	KMOX	7:00 P. M.; *Sundays.*
Organ Recital	KMOX	7:00 P. M.; *daily except Sundays.*
Drake Concert	WLIB	8:00 P. M.; *Tuesdays, Thursdays and Saturdays.*
Drake Concert	WGN	7:35 P. M.; *daily except Sundays.*
Brown-Palace Orchestra	KOA	8:30 P. M.; *daily except Thursdays.*
Benjamin Franklin Orchestra	WIP	6:10 P. M.; *Tuesdays, Wednesdays, Thursdays and Saturdays.*
McDonald's Orchestra	WIP	6:10 P. M.; *Mondays and Fridays.*
Bretton Hall String Quartet	WOR	6:30 P. M.; *Tuesdays and Fridays.*
Dinner Concert	WWJ	6:00 P. M.; *except Saturdays and Sundays.*
Jack Jacobs Orchestra	WOR	6:15 P. M.; *Mondays, Wednesdays, Thursdays and Saturdays.*
Twilight Musical	WAIU	7:00 P. M.; *Mondays, Tuesdays and Wednesdays.*

★ Programs of Dance Music

(Eastern Standard Time)

FEATURE	STATION	TIME
Colorado Orchestra	KOA	12:15 P. M.; *Saturdays.*
Packard Six Orchestra	KFI	1:00 A. M.; *Monday mornings.*
Coronado Orchestra	KMOX	1:00 A. M.; *Mondays, Tuesdays, Wednesdays, Fridays, Saturdays.*
Arrowhead Inn Dance Orchestra	WGBS, WIP	10:30 P. M.; *Tuesdays and Saturdays.*
McDonald Recording Orchestra	WGBS, WIP	10:50 P. M.; *Thursdays.*
Van Horn Dance Hour	WPG	10:30 P. M.; *Fridays.*
Casino Dance Orchestra	WPG	11:30 P. M.; *Saturdays and Mondays.*
Silver Slipper Orchestra	WPG	11:30 P. M.; *Tuesdays.*
Golden Pheasant Orchestra	WTAM	10:15 P. M.; *Sundays.*
Emerson Gill Orchestra	WTAM	10:00 P. M.; *Mondays and Wednesdays.*
Far East Orchestra	WTAM	11:00 P. M.; *Thursdays.*
Jade Room Orchestra	WTAM	11:30 P. M.; *Fridays.*
Simovar Orchestra	WENR	1:00 A. M.; *Thursday, Friday and Saturday mornings.*
Midshipmen Orchestra	KGO	12:30 P. M.; *Thursdays.*
Kats and His Kittens	WQJ	11:00 P. M.; *Saturdays, Tuesdays, Wednesdays, Thursdays and Fridays.*
WBAL Dance Orchestra	WBAL	11:00 P. M.; *Mondays, Tuesdays, Thursdays and Fridays.*
Renard's Orchestra	WEEI	10:10 P. M.; *Mondays.*
Joe Rine's Orchestra	WEEI	10:05 P. M.; *Wednesdays.*
Nighthawks	WBBM	1:00 A. M.; *Mondays;* 12:00 P. M.; *Tuesdays and Thursdays.*
Vincent Carr Orchestra	WIP	10:05 P. M.; *Saturdays.*
Vanderbilt Dance Orchestra	WOR	11:35 P. M.; *Tuesday.*
Cass Hogan's Orchestra	WOR	11:00 P. M.; *Wednesdays and Saturdays.*
Fletcher Henderson's Orchestra	WOR	11:00 P. M.; *Fridays.*
Kentucky Serenaders	KYW	11:30 P. M.; *Saturdays.*
George Olsen's Orchestra	WJZ	10:30 P. M.; *Tuesdays.*
B. A. Rolfe's Orchestra	WEAF	11:00 P. M.; *Mondays.*
Goodrich Zippers	WEAF	10:00 P. M.; *Thursdays.*
Johnny Johnstone's Orchestra	WJZ	10:30 P. M.; *Thursdays;* 10:50 P. M.; *Saturdays.*



Henry Miller

A PIN FOR EVERY BROADCASTING STATION

On this wall map, which hangs in the office of the radio division of the U. S. Department of Commerce, each of the 733 broadcasting stations in the country is indicated by a colored pin. Note the congestion in the New York, Illinois and the Pacific coast areas—and the "great open spaces" in the central and, particularly, the south-central sections. W. D. Terrell, chief of the radio division, is seen at the left.

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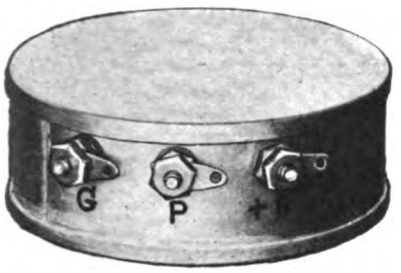

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30	Shielded Transformer	$2.00 each
24	Browning-Drake	7.50 set
18A	Roberts Circuit	8.00 set
25	Aristocrat Circuit	8.00 set

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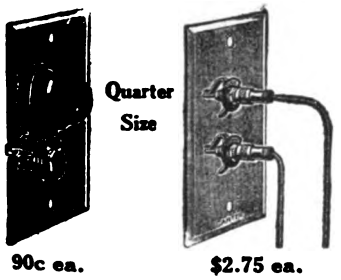

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CHICAGO

How to Assemble the Hammarlund-Roberts Hi-Q Receiver

(Continued from page 458)

nections; but be sure that you are using a good type of rosin-flux and follow instructions regarding the correct way to solder. Do not use any more solder than is absolutely necessary to make a good joint. Big gobs of solder will not hold the joint any more firmly, but may tend to weaken it.

It is an easy matter to make the necessary antenna, ground and battery connections to get the set in operating condition. The antenna wire may be connected direct with the switch arm terminal of the antenna switch, S. The ground connection may be made to the negative "A" battery terminal of the set, but it is preferable to make it direct to the negative terminal of the "A" battery itself.

The other battery connections are clearly shown and require no further explanation. For a standard UX-201-a type amplifier valve in the first low-frequency stage, V4, a negative "C" battery bias of 4½ volts should be used. If a UX-201-a type valve is used in the last stage, the negative "C" battery bias should also be 4½ volts, and it is best to use only 90 volts of "B" battery instead of the 135 volts indicated. If you use a UX-112 type tube, it is best to use 135 volts of "B" battery and 9 volts of "C" battery for the second low-frequency stage. If you use a UX-171 type valve you can still use 135 volts for the "B" battery, but you should use a negative "C" bias of approximately 27 volts, obtainable by adding a small 22½-volt "B" in series with the 4½-volt "C" battery.

You may now proceed with the job of balancing up the gang condensers and the adjustment of the midget condenser. Adjust the cams so that the coupling coils move in step and equalize the valve capacities of the high-frequency stages.

Once these adjustments are made, the tuning of the set is reduced to the simple operation of adjusting the two tuning dials and regulating the volume by means of the rheostat control.

A good antenna installation is necessary for efficient operation. This does not mean that your antenna should be stretched out over two city blocks. An aerial between 80 to 100 feet in length, including lead-in, will usually give the best results. Erect it free and clear of surrounding objects, and be sure that it is properly insulated at every point.

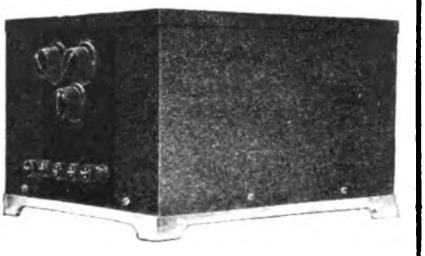
Fisherman's Luck

THE FISHERMAN *(who has taken up radio)*—I got Honolulu last night and you should have heard the stations that got away!

—LIFE

What Built the Reputation of Mayolian "B" SUPPLY ?

The "B" Without a Buzz



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Today, no matter what make or type of receiver you have, there is a Mayolian to give it a continuous, uniform, noiseless "B" supply—direct from the nearest light socket, at half the cost of burning a 25-watt lamp.

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Pioneers in Battery Elimination

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The Power of Niagara—
The Quiet of an Arctic Night

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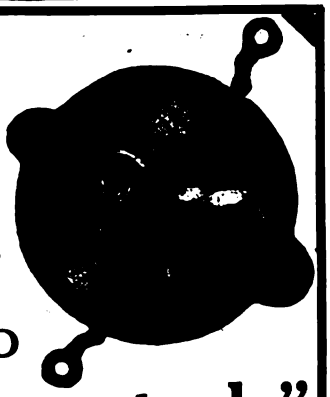

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The reverse; the name of each recipient will be engraved in the space provided.

The Popular Radio Medal *for* Conspicuous Service

TO every radio amateur, to every amateur experimenter and broadcast listener, who is instrumental in alleviating human suffering or saving human life, directly through the medium of radio, recognition will hereafter be extended in the form of a medal that shall be known as "The Popular Radio Medal for Conspicuous Service." This medal is unique within the realms of radio, in that it shall be awarded not for scientific achievement or invention, but for service to humanity.

To insure a fair and unbiased consideration of all claims, a Committee of Awards has been appointed that includes five distinguished citizens of international fame. To assist this Committee of Awards, an Advisory Committee has been appointed that numbers among its members some of the most eminent citizens of the United States, including representatives of many of our most distinguished institutions.

The conditions under which the medal will be awarded are here specified:

1. The medal shall be known as the Popular Radio Medal for Conspicuous Service.
2. The medal shall be awarded, without discrimination as to sex, age, race, nationality, color or creed, to those radio amateurs, radio experimenters, broadcast listeners and other non-professionals through whose prompt and efficient action radio is utilized to perform an essential part in the alleviation of human suffering or in the saving of human life within the territorial confines of the United States and its possessions, or in the waters thereof.
3. The medal shall be awarded by a Committee of Awards that shall not exceed five in number. No member of this Committee shall be an employee, officer or stockholder of POPULAR RADIO, INC., nor shall any such employee, officer or stockholder have a vote in the deliberations of the Committee.
4. An Advisory Committee, which shall co-operate with the Committee of Awards and which shall be particularly charged with the responsibility of making recommendations for awards of this medal, shall be made up of men and women who, because of their interest in the public welfare or because of their connection with institutions that are consecrated to public service, are in positions to bring to the attention of the Committee of Awards the exploits of candidates who are within their own special fields of activity.
5. The medal will be awarded for services rendered since Armistice Day, November 11, 1918.
6. Recommendations for awards may be submitted to the Committee of Awards at any time and by any person. Every recommendation must contain the full name and address of the candidate, together with a detailed account of the accomplishment on which the proposed award is based, and must be accompanied by corroboratory evidence from persons who have first-hand knowledge of the circumstances and whose statements may be verified to the satisfaction of the Committee of Awards.
7. The medal will be awarded to as many individuals as qualify for it and at such times as the Committee of Awards may authorize.
8. All considerations not specified herein shall be left to the discretion of the Committee of Awards.

All communications to the Committee of Awards may be addressed to—

The Secretary of the Committee of Awards, POPULAR RADIO Medal for Conspicuous Service, 627 West 43rd Street, New York.

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Listening In

(*Continued from page 469*)

denser will be found too large, bunching the stations at the lower end of the scale. This is a .001 mfd. condenser, and is large because the original design was so-called "second harmonic." The new arrangement being a fundamental heterodyne, a smaller condenser will be necessary, approximately .0005 mfd. But the old one may be used if it is carefully taken apart and 9 plates removed from the rotor, putting in an extra washer to take their place. The stations will then be found spaced evenly over the dial. The other dial can be adjusted as before by using the proper tap on the Korach loop.

Use 45 volts on the plate of the second detector and 90 on all the other tubes.

A set of the new type vernier dials, of which there are many on the market, will improve the appearance of the set, but are not necessary.

I find that these changes make this set much easier to handle, give as much volume and good quality as before, and while a certain amount of distance will be lost, it will still bring in all the distance that any but the most rabid DX hound will require.

—A. C. BERGENSTEIN, *Brooklyn, N. Y.*

* *

How to Construct a Simple Antenna Substitute

To construct this simple antenna substitute, cut two pieces of heavy cardboard to the dimensions given in Figure 4. Then paste a piece of heavy lead foil or tin foil, ¼-inch smaller all around than the cardboard, between the two pieces of cardboard. A length of flexible insulated wire should be connected between a binding post, put through the projecting end of the cardboard and lead foil and the antenna terminal on the receiver. The set should be grounded in the usual manner.

The unit may then be placed under a stand telephone; in this way, it really makes use of the telephone lines as an antenna by capacity; but it does not interfere with the operation of the telephone in any way. It may be used with the electric lighting lines in a similar manner by placing it under the flat surface of an electric percolator, toaster, or similar electric appliance. The appliance must be plugged in, but it is not necessary that the switch on the appliance be turned on.

While the unit may not in all cases give quite as good results as an outside antenna, it is portable and usually more selective.

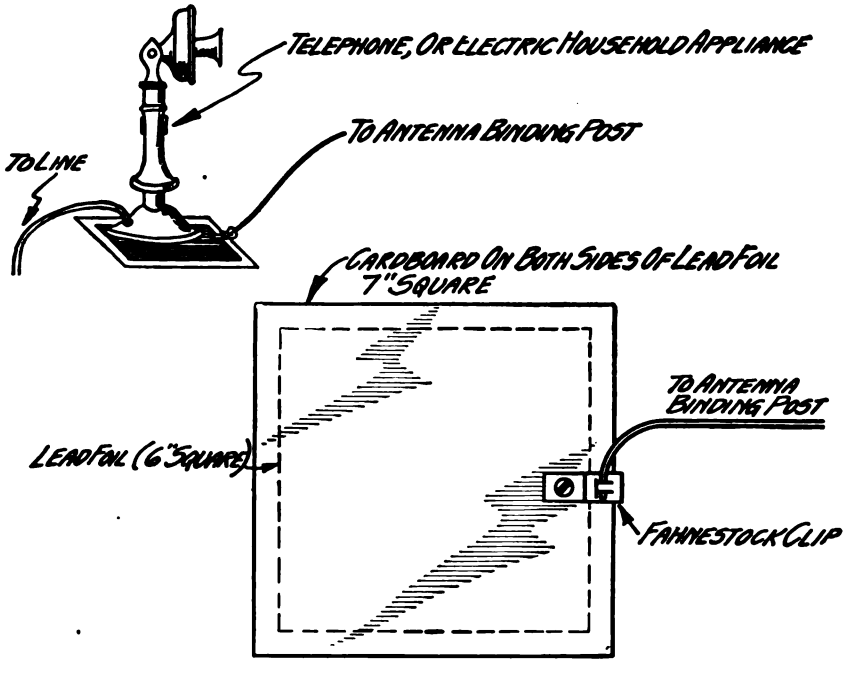
—CHARLES F. FELSTEAD (6CU), *Los Angeles, Cal.*

* *

How to Place a Single-cone Reproducer

WHEN using a single-cone type reproducer it will be found that greater volume occurs directly in front of the cone when the point of the cone is pointed at a wall opposite to the listeners. It has much more volume than when it is placed with the point of the cone directly towards the listeners.

—G. D. PRESTON, *El Centro, Cal.*


TELEPHONE, OR ELECTRIC HOUSEHOLD APPLIANCE
TO ANTENNA BINDING POST
TO LINE
CARDBOARD ON BOTH SIDES OF LEAD FOIL 7" SQUARE
TO ANTENNA BINDING POST
LEAD FOIL (6" SQUARE)
FAHNESTOCK CLIP

A SIMPLE ANTENNA SUBSTITUTE

FIGURE 4: *This diagram shows clearly a method for using the telephone line as an aerial where it is found impossible, on account of local conditions, to erect an outdoor antenna.*

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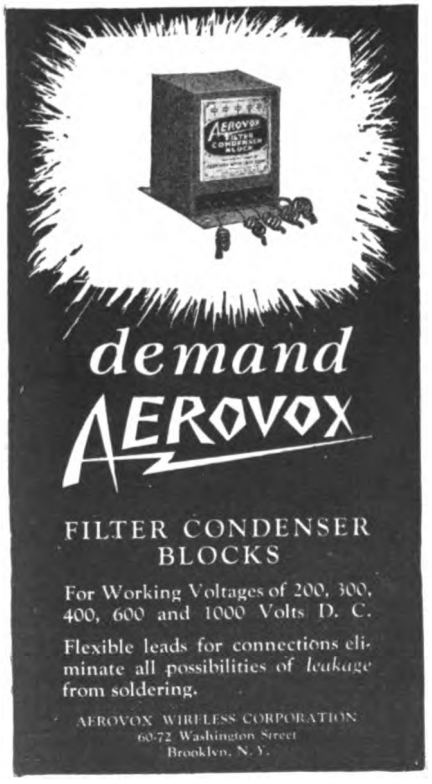
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Flexible leads for connections eliminate all possibilities of leakage from soldering.
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How to Care for Trickle Chargers

IN the use of a low-capacity, storage battery and a trickle charger the only attention required is the inspection of the battery. This should be done about once every month. The water should be kept above the plates of the battery. There are several types of trickle chargers on the market, and in the use of any of them care should be observed in the rate of charging. The rate should be sufficient to keep the battery at full charge at all times. When the charger is new and has just been put into use frequent readings should be taken to determine the condition of the battery. If the battery gradually runs low the rate should be increased and if it gases to a great extent it shows that the battery is full, and the rate should be reduced, to prevent excess charging.

—G. D. PRESTON, *El Centro, Cal.*

* *

A Light Globe to Protect Radio Tubes

Too frequently one hears the story, "I burned out five tubes, and it happened all at once."

Such experiences are costly; they are also unnecessary. By exercising a little care they may be prevented. I have found that a simple method to eliminate one of the big wastes of radio consists in using an ordinary electric lamp as a safety guard.

All that is needed for protection against such an accident is a 40-watt, 110-volt lamp—the kind found in most homes. The lamp is used when one is installing the set or is working on it to repair damages or to improve its reception efficiency. No matter what is being done to the receiver, there is no occasion for burning out the tubes. Without a safety device, however, this may happen because of an inherent defect in the set, because of an internal short in one of the tubes between the grid or plate and the filament, or because of carelessness in installing the receiver and connecting the battery wires.

Connect your lamp in series with the plus 90 "B" battery lead, and you cannot possibly burn out your tubes. Even if there is a defect of any nature in either the receiver or the connections, the 40-watt lamp safety protection will permit the tube filament to glow just dimly, and only when the filament control switch is still on the "off" position. If the tubes really light up with the switch in the off position, this circumstance is an indication of trouble somewhere, and the receiver should be disconnected at once and examined for the defect causing the disturbance.

When you have completely hooked up the set and made it function properly, you can safely remove the lamp, because the receiver is then in perfect shape.

—CHARLES OLIVE, Willmor, Minn.

High-Resistance Connections

ONE of the most common sources of trouble in a receiving set, and one which may easily be taken for something else, is the indifferent action of the set caused by a high-resistance connection. This is sometimes difficult to locate. It will cause the set to operate in an unsatisfactory manner, and is often mistaken for "location" trouble. A high-resistance connection may occur at any connection in the receiver, and one of the most frequent causes is the use of solder in which a corrosive flux has been used. Weak springs in jacks and switches are also common causes of high-resistance connections.

—G. D. PRESTON, *El Centro, Cal.*

* *

How Worn Parts May Make Receiver Noises

MECHANICAL parts, which have become worn, often cause noises in receiving sets that are attributed to loose connections in the wiring. In practically all sets the wiring is fixed and should not cause much trouble from loose connections ordinarily.

However, the vernier drive shafts of condensers often become worn; sometimes this also happens to the bearings of the vernier plates. When this occurs the contact between the shaft and the condenser may seem to be in perfect shape, yet the set, when critical tuning is necessary on distant stations, will not respond properly. There is a scraping noise or scratching sound heard that is often wrongly blamed on a loose connection in the wiring.

—G. D. PRESTON, *El Centro, Cal.*

A REAL DE-LUXE SET

FIGURE 5: *All the parts are gold plated and mounted on plate glass in this set and cabinet, built by J. W. Lake, of Dallas, Texas. It contains three stages of high-frequency amplification and two stages of low-frequency amplification. The design on the front panel is chipped and inlaid with gold leaf.*

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How to Make a Multiple Phone Connector

To make one of the multiple phone connectors shown in Figure 6, cut two pieces of thin brass strip to the dimensions given in the figure. The six small holes around the central hole are for the phone tips, and should fit them snugly. A ¾-inch piece of rubber cut from an inner tube is put between the two similar pieces of metal.

The whole assembly is held together by a small machine screw put through the central hole with a nut on the other side. The six outside holes are punched through the rubber, but are made smaller than the holes in the metal so the rubber will keep the phone tips from slipping out.

For a set that has binding posts, two of the phone connectors shown in Figure 6 at A should be made and one fastened on each binding post. This will allow the connection of as many as six pairs of head phones in parallel on the two binding posts.

For use with phone plugs, such as the Weston plug, multiple phone connectors like the one shown at Figure 6 at B should be made. The projecting end of the connector is rolled to the same size as the end of a phone tip, and is plugged in where the phone tip usually goes in a Weston or similar phone plug.
—CHARLES F. FELSTEAD (6CU), *Los Angeles, Cal.*

* *

What I Got on a Crystal

A FRIEND of mine gave me a home-made crystal set some time ago, saying that he couldn't get much on it. I hooked it up with a 100-foot antenna and received the station at Fort Worth, Texas, the first thing.

In time I logged 42 stations in all. Stations in New York City (1,500 miles away), Pittsburgh, Pa., and Denver, Col., were the farthest away on my list.

Even though we have a better receiver now, I still prize my crystal set. I am 15 years old.

—JIM CULLIPHER, *Hope, Ark.*

* *

How to Connect Old and New Dry Cells

IT is poor economy to connect new and old dry cells in parallel. This tends to ruin the good ones and will do the old ones no good. Little harm may be done if the two cells are connected in series, however. In a parallel connection the positive terminals are connected to positive and negative terminals to negative. In connecting in series, positive terminals are connected to negative and the end positive and negative terminals are connected to the output device that is being supplied with current.

—G. D. PRESTON, *El Centro, Cal.*

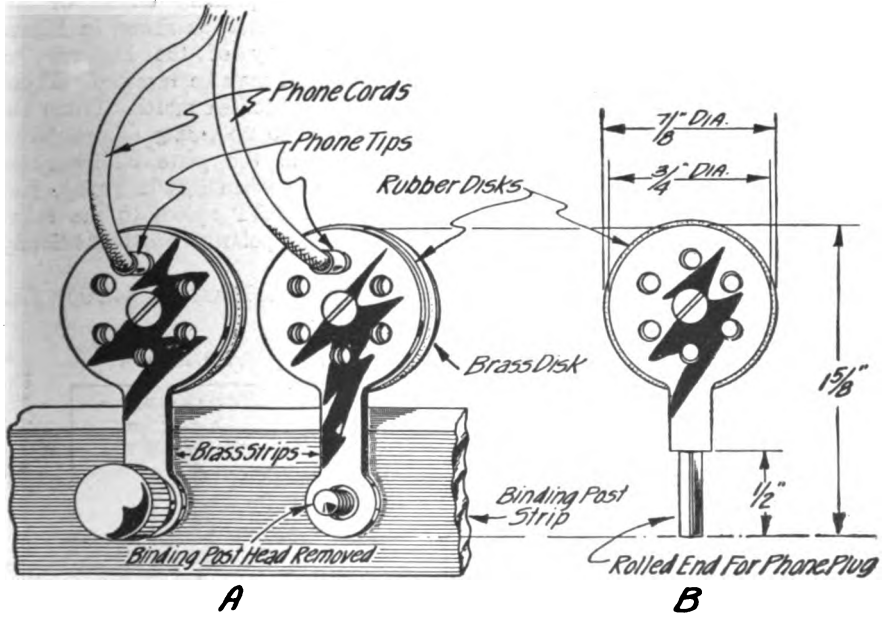
* *

How to Prevent Interference from a Swinging Antenna

How many listeners in realize that a swinging antenna with unsoldered joints will cause a vibration which may not only cause a noise in their own loudspeaker but in their neighbor's as well. The swinging may be so violent as to cause the antenna to come into contact with nails in the roof, rain gutters or other metal objects, thus causing untold trouble.

Have the antenna away from all obstructions, solder all joints, and pull tight enough to prevent excess swinging; this will eliminate interference from this source.

—G. D. PRESTON, *El Centro, Cal.*



CONNECTORS FOR SEVERAL HEADPHONES

FIGURE 6: *These drawings show how two simple connectors for use with a number of headphones are made; they also give all the necessary dimensions.*

KARAS MICROMETRIC VERNIER DIALS HELP THE "PRESELECTOR" TO ELIMINATE INTERFERENCE

Described in this issue of Popular Radio

BECAUSE the designers of the "Preselector," described and illustrated in this issue of POPULAR RADIO wanted a dial that positively insured split-second tuning, they chose the Karas Micrometric 63 to 1 Vernier Ratio Dial. They knew that no other dial had such remarkable control of tuning up to 1/1000th of an inch as does the Micrometric.

Two Karas Micrometric Vernier Dials are used in the "Preselector." When you build your set be sure to use Micrometrics to insure finest results.

An Action That is Velvety-Smooth

Micrometrics have a velvety-smooth action that is based upon a marvelous gear train that took us years to perfect. No friction gears—no cams—no makeshift devices—are used. So we offer you a vernier dial that turns smoothly, quietly and with truly micrometric precision. Stations that are usually hard to get with other dials are easily located with Micrometrics. Another advantage: when mounting these dials you merely tighten a single set screw. No extra holes to drill.

An All-Bakelite Dial, with Gold Inlay

Micrometrics add to the beauty of any set. They are made throughout of rich-looking black Bakelite, with all markings in gold inlay. You will be proud of their appearance on your receiver—and enthusiastic about their operation.

Your Dealer Can Supply You—Or Order Direct

Good dealers everywhere handle Micrometrics or can get them for you. If you are in a hurry and your dealer is out of stock you may order direct from us by filling out and mailing the coupon. SEND NO MONEY. Merely hand the postman the price of the dials, upon delivery, plus a few cents postage. Mail the coupon today for two dials for your "Preselector."

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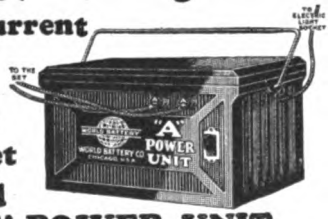

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IMPERIAL Valley, California, has the unique distinction of being the "lowest down" radio receiving area in the world. The one receiver there is located on the shore of Salton Sea, the largest inland body of salt water in this country; this set is owned by "Captain" Davis, a character of the western desert. The surface of the water of this great inland ocean is 249 feet below sea level.

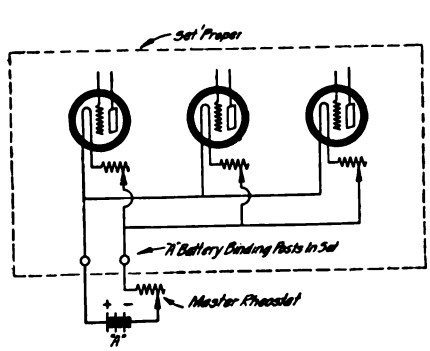
—G. D. PRESTON, *El Centro, Cal.*

* *

How to Connect a Master Rheostat in Your Receiver

No matter whether all the vaccum valves (or tubes) in a receiving set are of the same type or not, the rheostats in the filament leads of each of the valves will be found to give best results when adjusted to a certain value; and the proper value for each different one will be found to vary considerably. This is especially noticeable in a set using the old-style, gas-filled valves. When a separate filament rheostat is used for each valve—and to get the very best results out of the valves this is advisable—as the battery that supplies the filaments becomes weaker, all the rheostats have to be constantly readjusted if maximum results are desired. All this constant readjusting may be eliminated by connecting a master rheostat in one of the "A" battery leads to the set, as shown in the diagram. The master rheostat should have a current-carrying capacity a little greater than the total current taken by all the valves in the set. For a set using three C-301-a type valves, for instance, a six-ohm, one and one-half-ampere, master rheostat is of sufficient size. After the individual rheostats have each been adjusted to the correct value for the tube which they control, they may be left adjusted and the dropping of the "A" battery voltage as the battery becomes discharged may be compensated for by the master rheostat.

—CHARLES F. FELSTEAD (6CU), *Los Angeles, Cal.*



A MASTER RHEOSTAT

FIGURE 7: *This drawing shows how the rheostat should be connected in a receiver.*

Connection Loops Should Follow Screw Threads

WHEN wiring a receiver, care must be taken that the "loop" end of wire that goes round a binding post follows the screw thread. With few exceptions, all binding posts are threaded with a right-hand thread. Therefore the nuts are tightened to the left or clockwise. It is a good idea, when making a loop in the end of a wire which is to be placed on a binding post or a screw, to bend the loop in a clockwise direction or to the left so that the wire will not be twisted out from under the nut when it is tightened. Always make the loop in the same direction that the nut tightens in.

—G. D. PRESTON, *El Centro, Cal.*

* *

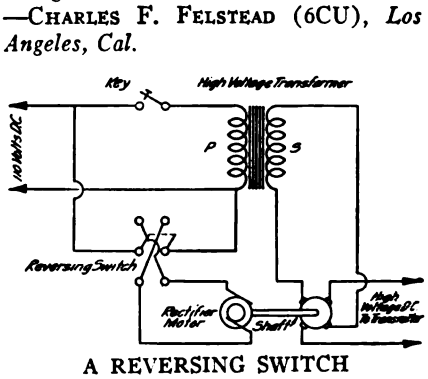
A Handy Reversing Switch for a Synchronous Rectifier

HERE is an idea for amateurs who use transformers and synchronous rectifiers to convert the alternating current in the house-lighting lines into high-voltage, direct current to supply to their tube transmitters.

If the synchronous rectifier is started on the wrong half of an alternation, the current from the rectifier will be of the wrong polarity. This will put the negative side of the line on the plate of the transmitting valve; and the set will not oscillate. Usually, when this happens, the amateur opens and closes the switch that connects the rectifier motor to the line until the rectifier comes up with the right polarity.

This method is not only extremely hard on the motor and the transmitting set, but it is also too slow and awkward for rapid transmission. By connecting a double-pole, double-throw (DPDT) switch in the primary circuit of the power transformer, as shown in Figure 8, the polarity of the high-voltage, direct current may be reversed without stopping the rectifier motor. When the polarity comes up wrong (the antenna ammeter and the plate milliammeter will not read when this happens), just throw the DPDT switch to the other side, and the polarity will immediately be righted.

—CHARLES F. FELSTEAD (6CU), *Los Angeles, Cal.*



A REVERSING SWITCH

FIGURE 8: *How the reversing switch should be installed for use with a synchronous rectifier on a transmitting set.*

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Gives better reception—closer selectivity and finer tone quality.

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Stations I Have Heard with My LC-26 Receiver

IN looking through my file of POPULAR RADIO I came across an item on page 554 of the October, 1926, issue, by a Mr. Tracy stating that he had logged 205 stations with his LC-26 receiver.

He wonders if this is an extraordinary result to be expected from an LC-26.

I don't think it is, as the following list of stations will indicate; all of these stations were received on the loudspeaker.

KDKA, KFAB, KFAE, KFBA, KFBD, KFDM, KFDX, KFEQ, KFH, KFLD, KFI, KFJF, KFJX, KFKU, KFKX, KFMQ, KFMX, KFNF, KFQB, KFRU, KFUL, KFUO, KFVE, KFVN, KFXF, KGO, KGW, KHJ, KFNG, KLDS, KMA, KMMJ, KMOX, KMTR, KNKV, KNX, KOA, KOCW, KOIL, KPO, KPRC, KSAC, KRLD, KWKH, KSBA, KSD, KSO, KSOE, KTHS, KTNT, KVOO, WAAD, KWWG, KWSC, KYW, WAAF, WAAW, WABC, WADC, WAHG, WAIU, WAMD, WAPI, WBAL, WBAP, WBBM, WBBZ, WBCN, WBZ, WCAD, WCAE, WCAP, WCBD, WCCO, WCEE, WCLS, WCX, WDAF, WCBS, WCRW, WCFL, WCK, WCBO, WDBE, WAED, WDBY, WDOD, WDZ, WEAF, WEAR, WEBC, WEBH, WEBK, WEBX, WEEI, WEMC, WENR, WEW, WFAA, WFAM, WFAV, WFBB, WFBM, WFBZ, WGES, WGBS, WGHB, WGHP, WGN, WGR, WGY, WHA, WHAD, WHAM, WHAS, WHAZ, WHB, WHBF, WHBM, WHK, WHN, WHO, WHT, WHST, WIBJ, WIBM, WIBO, WIBQ, WIBR, WIL, WIOD, WJAD, WJAN, WJAS, WJAX, WJAZ, WJBA, WKAN, WKAA, WJBB, WJBC, WJBL, WJBO, WJJD, WJR, WJY, WJZ, WKRC, WKVW, WLBL, WLIB, WLS, WLST, WLW, WLWL, WMAQ, WMCE, WMBB, WMBF, WMC, WMCE, WMXL, WKAQ, WOC, WOAI, WOAN, WOAW, WOI, WOK, WOO, WOQ, WOR, WORD, WOS, WOWO, WPG, WQJ, WRC, WRHM, WRLD, WRVA, WREO, WRM, WRR, WSAI, WSB, WSBC, WSKC, WSM, WSMB, WSL, WSWS, WSMK, WSOE, WSUI, WTAD, WTAM, WTAW, WTAX, WREC, WIBA, WJAM, CKY, CRNT, PWX, YBZ.

The above list totals up 208 stations which I think is sufficient to convince anyone that the LC-26 can secure the results.

I think two of the stations need mentioning in particular. KFUL, a ten-watt station at Galveston, and WREC, a ten-watt station at Coldwater, Miss., were brought in with no trouble at all. KFUL has since increased its power.

I think this will convince almost anyone that Mr. Tracy's record is nothing out of the ordinary and that anyone building a set of this type can expect the same results.

—W. R. BATTEN, *Peoria, Ill.*

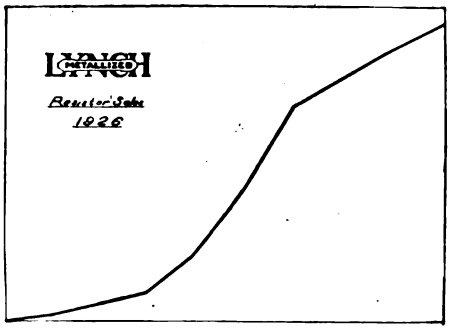
* *

How to Care for Jacks and Switches

JACKS and switches are important and should be looked after occasionally. Try a plug in the jack and see that there is not too much play. A poor contact will cause a lot of trouble after the set has been in operation for some time. The springs should be tested in the same manner as a socket. There are several makes of jacks on the market, many of them good, but in a short jack special care should be paid to the springs. In switches made in the form of jacks the spring should be rather heavy to get a good contact. In the closed types, dependence will have to be placed on the name of the maker.

—G. D. PRESTON, *El Centro, Cal.*

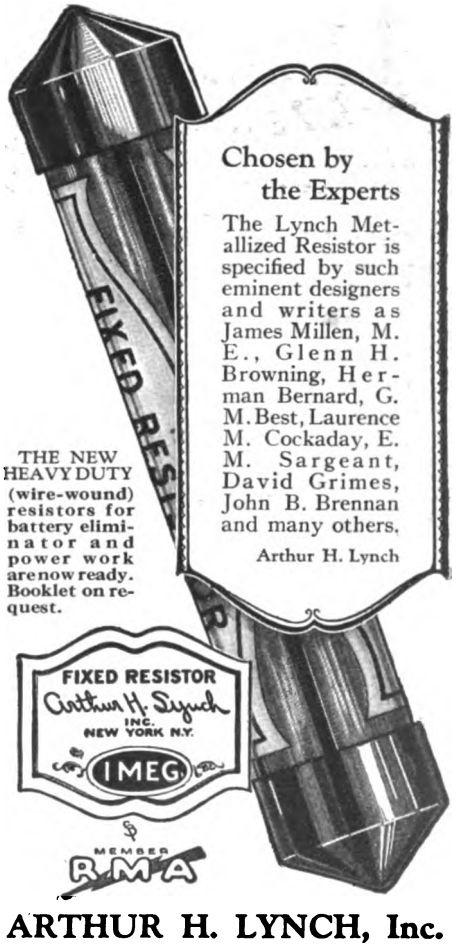
SALES!



THERE is much truth in the old adage: "Figures *don't* lie." The above graph showing our ever-increasing sales is proof positive of the true merit of the Lynch Metallized Resistor.

Endorsed and Used by Leading Manufacturers

Crosley, Ferguson, Gilfillan, Grimes Engineering Corporation, The National Company and other leaders in the industry use the Lynch Metallized Resistor and other products. These manufacturers realize that "the proof of the pudding is in the eating."



Chosen by the Experts

The Lynch Metallized Resistor is specified by such eminent designers and writers as James Millen, M. E., Glenn H. Browning, Herman Bernard, G. M. Best, Laurence M. Cockaday, E. M. Sargeant, David Grimes, John B. Brennan and many others.

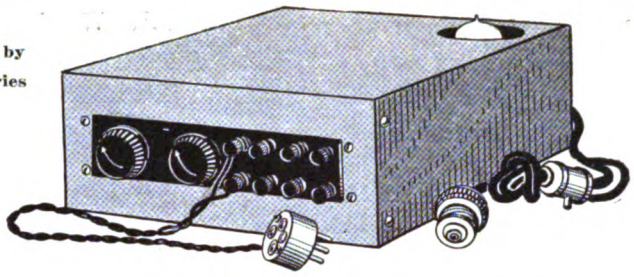
Arthur H. Lynch

THE NEW HEAVY DUTY (wire-wound) resistors for battery eliminator and power work are now ready. Booklet on request.

ARTHUR H. LYNCH, Inc.
Fisk Bldg., Broadway & 57th Street
New York, N. Y.

LYNCH METALLIZED
FIXED RESISTORS

Approved by Raytheon Laboratories



The engineering skill of these fine parts manufacturers was employed to produce this new

VARION

AMERICAN TRANSFORMER CO.
CENTRAL RADIO LABORATORIES
H. H. EBY MANUFACTURING CO.
SANGAMO ELECTRIC CO.
WARD LEONARD ELECTRIC CO.

16 mfds of condensers assures reserve energy necessary for good reproduction

At 100 ma drain, Varion passed the Raytheon Laboratoriesstandard hum test

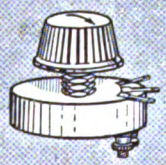
200 volts at 60 ma drain

2 C-bias voltages, one variable from 0-45 volts

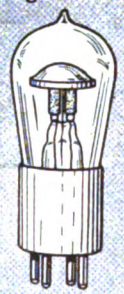
A-current for 171 power tube available if desired

COMPONENT PARTS

Eby Ensign Binding Posts

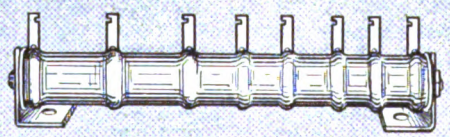


Centralab Heavy Duty Resistors

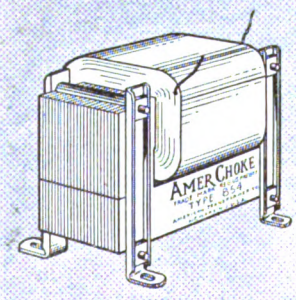


Raytheon B H Rectifier

Sangamo Wound Condenser Block

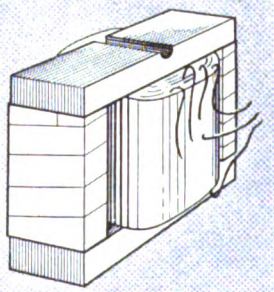


Ward Leonard Vitreous Enamelled Permanent Resistor



AmerTran Amerchoke #854

Sangamo Wound Condenser Block



AmerTran Special Transformer, designed exclusively for Varion Current Supply Unit

VARION

Current Supply Unit

In the World's Laboratories

(*Continued from page 471*)

In both cases, certain points on the water or on the rope will seem to be still. The motion of the wave passes through them, but the points themselves are not moved.

In an extremely crude manner, this gives some idea of the Schrödinger viewpoint of electrons. The real material of the universe is seen as ether waves, although the idea of the ether is not necessary. A mere universe of waves is enough. At certain places or under certain circumstances these waves create what seem to us persistent entities, like the apparently motionless points on the water-surface or along the rope. These are the electrons and protons. And these are also, it must not be forgotten, ourselves; for whatever theory we assume as to the nature of the proton and electron, we shall not escape the fact that it is of these mysterious entities that every human body and every particle of the material world are made.

Oxide Coatings Do Not Alter Wire Resistance

ANOTHER familiar radio delusion has been exploded. For years it has been imagined that the coating of oxide and other corrosion products which forms on wires of copper or brass when they are exposed to the air had a considerable effect in increasing the resistance of such tarnished wire to high-frequency electric currents. By the well-known "skin effect" it has been assumed that the electric current would tend to seek the outside layers of the metal in such wires. As these outside layers were converted more or less completely into the low-conductivity oxide or sulphide of copper, it was imagined that the passage of the current would be impeded notably. The use of silver wire in radio, prominently suggested a year or two ago, rested on the theory that the corrosion products of silver are conducting instead of non-conducting and that they would not so greatly impede the flow of current.

All this was a plausible theory. The only detail the matter with it is that it turns out to be untrue. It is so proved by the best test in the world.

Someone has tried it!

The someone is Dr. Wesley M. Roberds of the Blake Physical Laboratory, at the University of Kansas. It has been reported many times recently that the resistance of copper wires to currents in the neighborhood of 10,000 kilocycles (30 meters) does not correspond, when measured, to the values predicted by the theoretical formulas for high-frequency resistance and given in the tables in the textbooks. Dr. Roberds set out to test this discrepency. Working at 8600 kilocycles

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and at 15,000 kilocyles, he tested number 16 copper wire and number 16 silver wire for the exact values of electric resistance. When precautions were taken to equalize the distribution of the current in all parts of the loop of wire that was being measured, the values found were sufficiently close to those predicted by the theory to constitute an adequate vindication of the latter.

The interesting observation on the lack of effect from oxide coatings Dr. Roberds made incidentally to his other investigation.* Resistance curves run on bright copper wire were found to coincide with curves run on the same wire after it had acquired a heavy coating of oxide. "If the acquisition of oxide by copper wire causes any change in resistance," Dr. Roberds reports, "it is very small."

* "The Resistance of Copper Wires at Very High Frequencies," by W. M. Roberds. *Physical Review* (Minneapolis), volume 29, pages 165-173 (January, 1927).

How Listeners Affect the Broadcast Wave

IT HAS long been a theoretical conclusion in radio that the presence near a broadcasting station of a large number of receiving antennas tuned to that station will affect the intensity of the broadcast wave. Each antenna abstracts, of course, a small fraction of the wave energy, and theory indicates that the antenna will withdraw this energy from a portion of space somewhat larger than the space which the antenna actually covers. A forest of tuned antennas, such as now decorates the housetops of virtually every city, ought to have a substantial effect in depleting the wave; an even greater effect than would be registered by an equal amount of metal in the form of such untuned objects as the frames of buildings or the like.

That this is actually the case is suggested by the recent interesting measurements made by the well-known British radio expert, Mr. R. H. Barfield, of the Radio Research Board of the Department of Scientific and Industrial Research.† Mr. Barfield's measurements were made on the wave from station 2LO, in London. Setting up his portable receiving apparatus in different locations on the outskirts of the city, Mr. Barfield discovered that when his receiving location was one characterized by the presence of many antennas in a line between it and 2LO's transmitter, the wave strength received fell off substantially. On the contrary, when the location was such that only a few receiving antennas were located between the transmitter and the receiver,

† "Effect of a Large Number of Receiving Aerials on the Propagation of Wireless Waves," by R. H. Barfield. *Nature* (London), volume 119, pages 195-196 (February 5, 1927).

MORISON ANNOUNCES

THE NEW

Varion

Current B&C Supply Unit

with a message for radio fans and radio dealers

PRACTICALLY every B Eliminator will stand up under 200 volts for the first few days. When you try it out, before you buy it, it tests O. K.

But it isn't long before you have trouble. The parts aren't built to stand the gaff. And the only answer is returns, changes, tinkering and trouble—and the fan and dealer both suffer.

The Varion stays sold—*and satisfactorily sold.* The dealer handles it once, and he's through handling it. When you buy the Varion from him, you put it to work and forget it.

And here's why—

1. The majority of B Eliminators are controlled by variable resistances. The demands made by the larger sets call for amperage which these variable resistances can not stand up under. The Varion uses definite fixed resistances which will take all the amperage any radio set draws.

2. The resistances used are designed to meet electrical standards of excellence. You are sure of permanent satisfaction.

3. In the past, filter condensers were made to withstand the usual operating voltages, but not the surge voltage. Varion filter condensers are designed to take the maximum surge voltage.

4. The demands of the old B type rectifying tube were greater than the tube could stand. The Varion uses the improved types of rectifying tubes which can easily handle 200 volts at 60 mils.

5. The Varion operates equally well in any position. It is particularly suitable for the Radiola 28, because it is compact enough to fit into the Radiola 28 battery space.

COMPLETE LIST OF PARTS USED

1 AmerTran Transformer, PF-64 (unmounted)	$8.00
2 Amerchokes, No. 854	12.00
1 Sangamo Varion Condenser Block, 14 mfds. total capacity	10.25
1 Sangamo Varion Condenser Block, two .1 mfd. units with one common terminal	1.75
1 Eby UX-type Socket	.50
1 Ward-Leonard Varion Resistance Unit 12,000 ohms total resistance	6.75
1 Ward-Leonard Resistance, 5,000 ohms	1.50
1 Ward-Leonard Resistance, 2,250 ohms	1.25
2 Any Approved Heavy-Duty Potentiometers, 2,000 ohms (Centralab Units illustrated)	4.00
8 Any Approved Binding Posts (Eby Posts illustrated)	1.20
1 Drilled and Engraved Bakelite Panel, 2" by 9" by 1/8"	.75
1 Attachment Plug	.15
1 Beaver Feed-Thru Switch	.50
1 Any Approved Fuse Plug, 6 amperes (Economy Plug illustrated)	.10
1 Hart & Hegeman Receptacle, No. 9154	.20
1 Stamped and Drilled Metal Case	3.50
1 Brass Mounting Bracket for Transformers	
3 Doz. 6/32 Brass Machine Screws, 3/4" long	.60
4 6/32 Brass Machine Screws, 1 1/8" long	
1 6/32 Brass Machine Screw, 2 1/2" long	
1 Tobe Filter Condenser, 2 mfds.	1.75
6 Ft. of Standard Lamp Cord	.25

Absolutely complete—nothing else to buy, including the new BH type Tube, $55.00.

COMPLETE KIT $55 AND WORTH IT

VARION ADAPTOR, $2.50 ADDITIONAL

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Coils to your Specifications

Beginning May 1st, the Precision Coil Co. is inaugurating a new service to radio experimenters and set builders—the building of solenoid coils to measurement.

Send exact specifications as to diameter of tubing, number of turns and size of wire. (A word of caution—we cannot attempt to build coils for any given capacity of condenser. *Exact* specifications must be given.)

Upon receiving specifications we send you an estimate of cost. You then send your check or money order to cover, and we proceed. Shipments are prepaid anywhere in the United States.

PRECISION COIL CO., INC.
209 Centre Street, New York, N. Y.

play safe

THE heart of the socket power unit is the variable resistor. Don't experiment with that important organ. Use CLAROSTAT. Its ability to cover the entire range and its current-carrying capacity of 20 watts is essential if your unit is to furnish quiet, uniform power year after year.

CAUTION! CLAROSTAT is being imitated. Don't be misled. Insist on seeing the name which is stamped on every genuine CLAROSTAT.

Twenty-five cents never bought more value! "The Gateway to Better Radio," 32 pages of interesting reading, diagrams and illustrations covering everything in radio-amplification, transmission, socket power unit construction.

Send 25 cents in stamps or coin to
American Mechanical Labs., Inc.
281 N. 6th St., Brooklyn, N. Y.

CLAROSTAT

Send 25c for 32 page illustrated book

the diminution of the wave strength was much less noticeable. It is assumed, probably correctly, that virtually all of the antennas in the city would be tuned to the one station, 2LO, as London possesses no other broadcasting station in ordinary use. It is probable that all of the Londoners are occupied with 2LO if their receivers are in use at all.

Obviously, these measurements are open to a certain criticism, through the possibility that some of the absorption may have been produced by buildings or other objects which may possess an exceptional absorbing capacity in one direction or another around 2LO. However, since London is built of rather uniform construction in all portions of the city, this conceivable error is probably much less important than would be the case were similar measurements attempted in an American city, where the steel frame construction (probably the largest seat of absorption) is commonly localized in certain definite areas.

Radio engineers have long hoped for some device by which the operating engineers of a broadcasting station could determine their moment-by-moment "load"; some device by which the number of listeners tuned in on that wave would be perceptible to the transmitting engineer. For example, if there went on the air some feature notably popular, that fact would be indicated immediately by a sudden increase of the "load." On the other hand, when a popular feature was succeeded by one less admired, the reaction of the audience would be obvious instantly by a fall in the number of listeners.

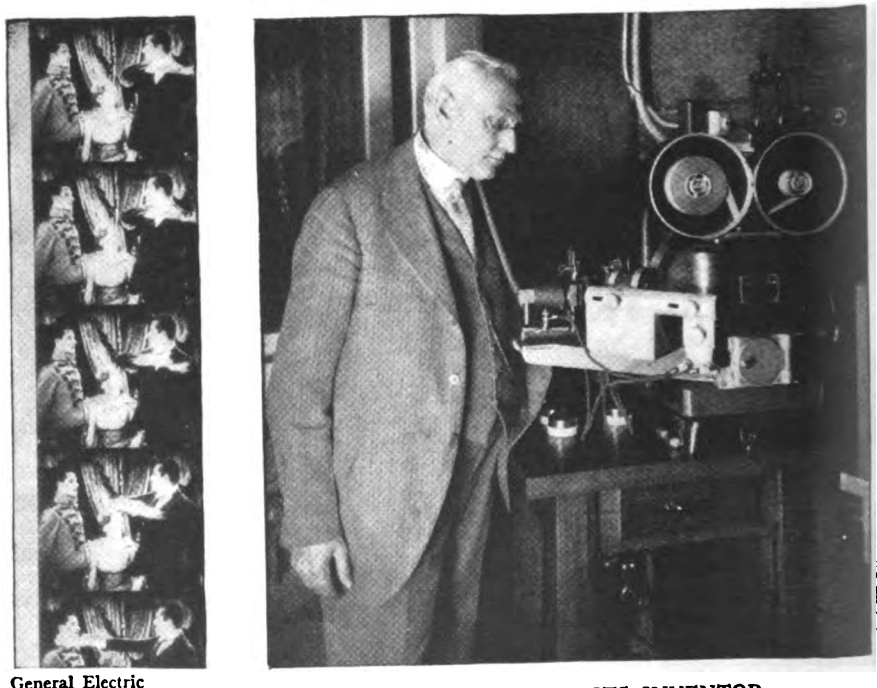
Although Mr. Barfield's results may be considered by optimists a step in this direction, they unfortunately do not indicate, for the moment at least, any method of devising this most desirable indicator for the attitude of the broadcaster's audience.

Two New Talking Movies

ON January 29th, at Schenectady, New York, the General Electric Company demonstrated a new system for the production and presentation of a talking motion picture. Less than a month later, on February 28, the Fox-Case Laboratory presented in New York City a similar demonstration of their new speaking motion picture system, the so-called "Movietone."* Thus there are added to the Vitaphone two new competitors providing the addicts to motion pictures with three separate and distinct systems by which it is expected to be possible to synchronize sight and sound.

The Vitaphone system (demonstrated some months ago and already described in this department) employs a sound record constructed on the basis of the phonograph. Wax discs are prepared exactly as in phonograph technique and

* Information from press releases distributed by the General Electric Company, Schenectady, N. Y., and the Fox-Case Studios, New York City, respectively.



General Electric

THE NEWEST "TALKING MOVIE" AND ITS INVENTOR

At the left is a reproduction of a strip of the new General Electric "talking motion picture," in which the record of the sound is photographed on the same strip of film with the moving picture itself. The sound record is represented by a number of very fine horizontal lines (too fine to be visible in this reproduction) forming a ladder-like strip at the left of the strip of motion picture. In front of Dr. Hoxie is the apparatus with which the sound record is photographed. The original photographic negatives, recording the sound and the motion picture, may be photographed separately and the records put together, later on, on the finished film.

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are run off simultaneously with the picture, the proper synchronism of sight and sound being provided by the automatic control of speeds for the film projector and the phonographic device which turns the wax record.

The Vitaphone's two new competitors operate differently. In both instances the sound record is carried on the same film which carries the motion picture, a procedure used in the original phonofilm of Dr. Lee de Forest, first presented several years ago. In the system of the General Electric Company, the sound record is made on the film by means of a vibrating mirror, the motion of which responds to the vibrations of sound. By a combination of lenses and slits this vibrating mirror is made to photograph on the motion picture film a succession of dark and light lines. The number of these lines on each inch of film corresponds to the pitch of the tone being sounded. At the same time the light or dark intensity of the lines corresponds to the loudness of the sound.

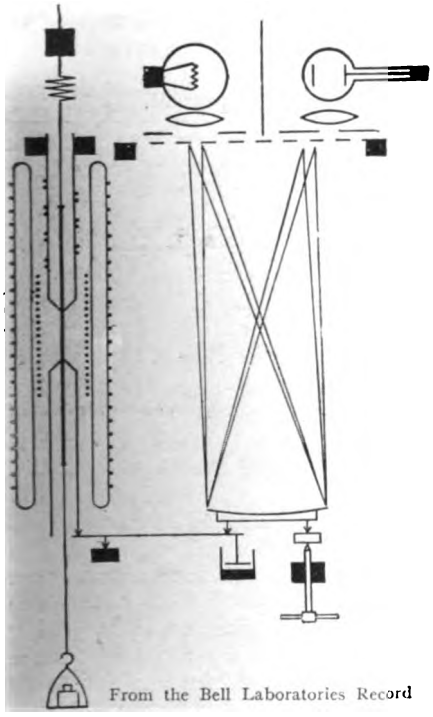
Essentially the same result is obtained by the "Movietone" method, but the variation in the intensity and spacing of the light and dark lines, instead of being provided by the vibration of a mirror, is arranged for through the variation in the intensity of the light emitted by a special lamp, christened the "Aeo" lamp. In both instances the original sound vibrations which it is desired to record are converted into electric vibrations by means of microphones and amplifiers, in the usual fashion. These electric vibrations are then impressed either upon the vibrating mirror or upon the "Aeo" lamp, thus creating the variable images which are photographed. The system reproducing the sound record is essentially the same in the two instances, the variation of light from a lamp shining through the film being transmuted by a photoelectric cell into electric vibrations which are then amplified and reproduced by loudspeakers according to substantially standard technique.

The new systems which photograph the sound record upon the same film with the motion picture record possess, it is obvious, the advantage of simplicity over the Vitaphone, which is compelled to use a combination of phonograph record with a separate motion picture film.

It is announced that the "Movietone" has been developed and will be operated in collaboration with the Vitaphone, with the Case Laboratories of Auburn, New York, and with the Bell Telephone Laboratories.

It is probably too soon to predict with any assurance just what rôle the talking motion picture is apt to play in the life of the world or just which of the various systems developed or proposed is likely to come out on top after the inevitable period of competition is finished. Judging by the demonstrations which have been given recently, and by the period of experience, now substantial in the case of the Vitaphone, any one of the three systems above described will probably be satisfactory for the needs of the theatrical industry and of the public. Many additional systems have been claimed or demonstrated, both here and abroad. It is probable that some of them will prove equally satisfactory with the three above described.

Thanks to the development of the radio art and its related arts and sciences, there is now no doubt that the great motion picture public of the world will be permitted to enjoy whatever combination of sight and sound their hearts may lead them to desire.



From the Bell Laboratories Record

A PHOTOELECTRIC FOOT RULE

The arrangement of the apparatus used by Mr. P. P. Cioffi to measure changes of length to one part in four billion; at the lower right-hand side of the diagram is the mirror, which is tilted slightly by the expansion of the metal specimen held down by the weight at the left. The light ray from the lamp at the middle of the top of the diagram is thus reflected into the photoelectric cell at the upper right-hand corner, or to one side of it.

The World's Finest Foot Rule

THE newest of physical devices, the photoelectric cell, has been put to use recently in a new direction—as the essential element in a measuring device far more sensitive than any yet developed.

With this apparatus, the invention of Mr. P. P. Cioffi, of the Bell Telephone Laboratories, it is possible to measure the length of a specimen of metal within four parts in a billion, more than two

Your Aerial is Subject to Lightning Induction

Safety Demands a BRACH Storm King ARRESTER

BECAUSE—

It Gives Maximum Protection
It Will Not Ground
It Will Not Affect Reception
It Carries $100 Free Insurance

[*20 Years Standard on America's Leading Railways*]

OVER 2,000,000 RADIOS ARE PROTECTED BY BRACH ARRESTERS

Brach Radio Products

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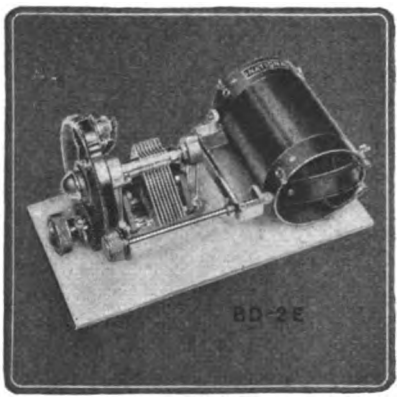
NATIONAL TUNING UNITS



New Type Designed and Officially Approved by Glenn H. Browning

These new NATIONAL TUNING-UNITS comprise the OFFICIAL BROWNING-DRAKE Coils and R. F. Transformers; mounted on the New NATIONAL EQUI-TUNE Variable Condensers with their light, rigid Girder-Frames. Each TUNING-UNIT is fitted with a NATIONAL ILLUMINATED VELVET-VERNIER DIAL—Type C, with variable ratio and smoothest action. Each tuning unit is packed mounted as shown so that it may be used without change for experimental work or easily installed on a panel.

NATIONAL TUNING UNITS COVER THE BROADCAST BAND

Price BD-1E, with Genuine BD Antenna Coil and .0005 Condenser, $10.75.
Price BD-2E, with Genuine B-D Transformer and .00025 Condenser, $14.25.

NATIONAL Tuning Units are standard for good Radio sets. So are NATIONAL Impedaformers for quality audio. NATIONAL Tone-Filters for power tube output connection.

NATIONAL Co. makes heavy-duty B-Supply Units and 4-stage Power Amplifiers. Write National Company, Inc.; W. A. READY, President, Cambridge, Mass. for Bulletin 116-L-5.

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NEW 1927 Radio Catalog

BEFORE you build or buy a radio be sure to consult our new 100 page catalog — sent to you free. All the latest kits, accessories and parts — a million dollar radio stock to choose from.

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We handle only brand new apparatus — standard makes that are fully guaranteed. QUANTITY sale of QUALITY parts explains our low prices. Compare with others and see why thousands of fans look to us as radio headquarters. Write for your copy of this new catalog today.

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thousand times as accurate a measurement as has been possible by previous devices.*

The need of this accurate foot rule arose in connection with some investigations of what is called "magnetostriction"—a property of certain magnetic metals to expand or contract slightly when subjected to powerful magnetic forces.

These changes in length or volume are very minute. It is not apparent, for example, that a steel needle actually contracts or expands when its magnetism is altered. Nevertheless, careful scientific tests have shown this to be the case and the effect has come to have great scientific importance in connection with several modern theories dealing with magnetism.

In studying these effects accurately, Mr. Cioffi found it impossible to measure the changes in which he was interested by ordinary means. Accordingly, he devised an apparatus in which the very minute expansion or contraction of the metal bar produces a tilt in a small mirror mounted on a flexible support. The tilting of this mirror slightly alters the direction of a light ray reflected from its surface. This alteration in the ray is detected, in turn, by a sensitive photoelectric cell upon which the light ray falls. By an ingenious combination of narrow slits, lenses and other optical apparatus, Mr. Cioffi is able to convert the alteration of direction thus measured into a measure of the change of length of the metal specimens which he is examining.

It has been predicted frequently in this Department that the photoelectric cell, possessing the unusual property of being able to convert light rays into electricity, is apt to be as important an instrument in scientific investigation and in practical engineering as the vacuum tube itself has proved to be. Readers of this Department will remember the ingenious apparatus constructed under the direction of General Ferrié for the purpose of recording starlight. Mr. Cioffi's accomplishment is another document in this same direction.

* "Measuring to Four Parts in a Billion," by P. P. Cioffi. *Bell Laboratories Record* (the magazine printed for circulation to the staff of the Laboratories), volume 3, pages 201-204 (February, 1927).

Electrical Prospecting

THE many scientific devices which have recently come to the aid of the business of prospecting for mineral deposits cannot help but possess the greatest interest for everybody. There is no business more romantic than that of trying to find precious metals in the earth. While the lovers of the picturesque may regret the passing of the older prospector and his burro, the world will undoubtedly be better off when he has been superseded by the radio engineer with his transmitters and telephones and other machines for peering into the interior of the earth's crust.

Undoubtedly, the most successful method devised to date of accomplishing electrical prospecting is that worked out in Sweden for the examination of the earth to determine whether or not iron deposits are present.

Underwood & Underwood

LISTENING FOR BURIED TREASURE IN THE GROUND

In this picture Mr. Hans Lundberg (at the center) is prospecting for ore deposits in a Swedish mineral district, using modern electric methods. Electric currents similar to the audio-frequency currents of radio are fed into the rock strata suspected of containing mineral deposits. The directions in which these currents pass through the rocks are then detected by radio-telephonic methods, thus indicating where mineral deposits may be expected.

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POPULAR RADIO maintains for the benefit of its readers a Technical Service Bureau and Laboratory, which will, without charge, answer by personal letter any question or problem submitted by a subscriber. **This service is, however, also available to readers, other than subscribers, at the very nominal rate of $1.00 the inquiry.**

In writing please confine your questions to one general subject, writing on one side of the paper only, and enclose a self-addressed and stamped envelope.

It is possible that your individual problem has been covered in an issue of POPULAR RADIO, and so as an aid to you we endeavor to keep a supply of back numbers in stock. The condensed index below gives a few of the subjects that have appeared recently: look this list over and if the information you want is covered, we will be pleased to supply back numbers at 35c. a copy.

May, 1926
—How to Draw Up Your Own "Tuning Graphs."
—How to Build the Improved Raytheon Power-pack.
—How to Build an Antenna Mast for $15.00.
—Fifteen Ways to Reduce Static.
—Do Your Coils Broadcast?

June, 1926
—How to Build the New Home Receiver.
—How to Put Up a Good Outdoor Antenna.
—How to Get the Most Out of Your Ready-made Receiver.
—Audio-frequency Amplification. How to Get it Without Distortion.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.

July, 1926
—How to Get the Best Reception in Summer.
—The Best Crystal Set for $13.00.
—How to Build the Newest Portable "Town and Country" Receiver.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.
—How to Get the Most Out of Your S-C Receiver.

August, 1926
—A New Method of Using Harmonics for Determining Frequencies.
—POPULAR RADIO Circuits.
—How to Build the Improved Browning-Drake Receiver.
—How to Pick Out a Loudspeaker.
—How to Get the Most Out of Your "Town and Country" Receiver.
—Three Vacuum Tubes in One.

September, 1926
—Foretelling Radio Reception from the Weather Map.
—How to Build an Impedance-coupled Amplifier.
—A Radiant Crystal Pilot.
—POPULAR RADIO Circuits.
—How to Simplify Your Set with Automatic Filament Controls.
—Inside Information on New Radio Receivers.
—How to Wire Your House for Radio.

October, 1926
—How to Build the New LC-27 Receiver.
—The Radio Road Hog.
—POPULAR RADIO Circuits.
—Sets That Earn Incomes.
—Inside Information on New Radio Receivers.
—Why Signals Fade.

November, 1926
—How to Build the LC-Senior Power-pack.
—Waves and Wavelengths.
—POPULAR RADIO Circuits.
—How to Select Your Radio Parts.
—How to Patent Your Radio Inventions.
—How to Solder.

December, 1926
—Uncle Sam's New Short-Wave Net.
—How Circuit Resistance Affects Selectivity.
—POPULAR RADIO Circuits.
—How to Build the LC-Intermediate Power-pack.
—Inside Information on New Radio Receivers.

January, 1927
—How to Build the New KH-27 Receiver.
—To Start and Stop Your Set Automatically.
—POPULAR RADIO Circuits.
—The Quack Doctors of Radio.
—How to Build the LC-Junior Power-pack.

February, 1927
—The Coming of the "RADIO UNIVERSITY."
—How to Get Quality Amplification.
—How to Build and Use a Portable Test-Board.
—How to Assemble the All-Amax Senior Three-tube Reflex Receiver.
—What's New in Radio.

March, 1927
—How to Build the Univalve Receiver.
—POPULAR RADIO Circuits.
—How to Increase the Range of Ammeters and Voltmeters.
—How to Build Your Own 36-Inch Cone Loudspeaker.
—What's New in Radio.

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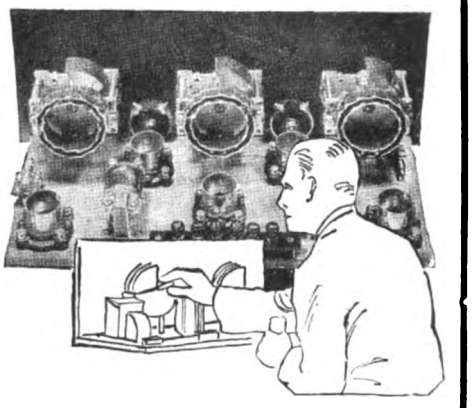

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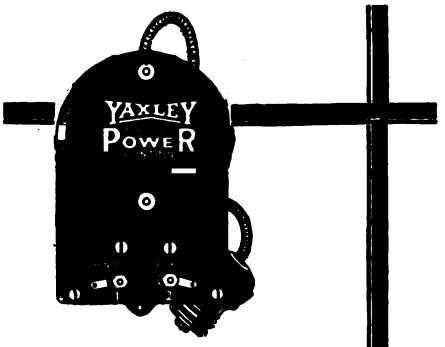

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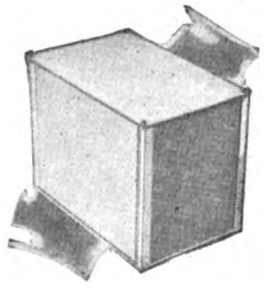

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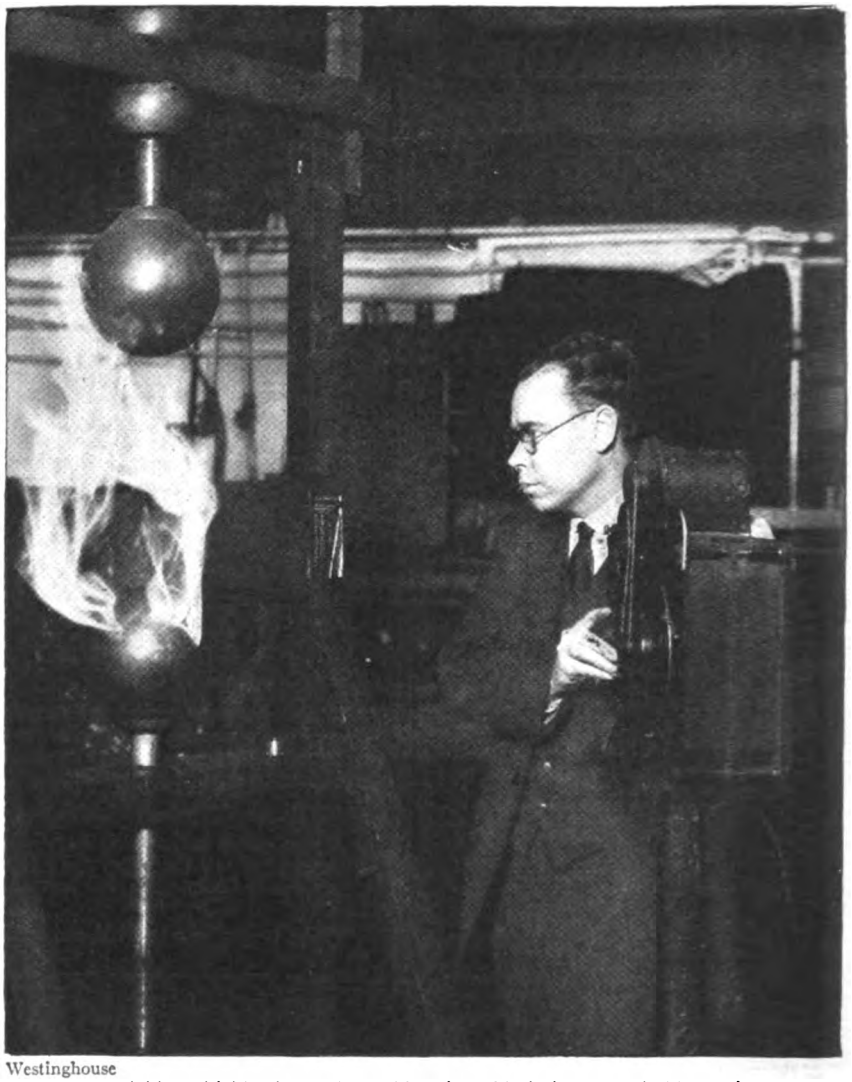

Westinghouse

HE TAKES THE PORTRAIT OF ARTIFICIAL LIGHTNING

Mr. J. W. Legg is shown with his new high-speed photographic camera, which will make twenty-two separate photographs of a lightning flash, each in less than one two-thousandth of a second. In the picture the arc passing between the large high-voltage terminals at the left is being photographed by Mr. Legg's camera. Eleven pairs of lenses are used, being opened in succession by a high-speed shutter. The resulting photograph is like that shown in a sample plate reproduced on the following page.

"Corkscrew" Lightning

ALTHOUGH lightning is probably the oldest natural phenomenon observed by man (for who can doubt that even the cavemen watched it and feared it?) it is surprisingly ill understood. That it consists of vast electric discharges from cloud to cloud or between the clouds and the earth there can be no doubt. The accompaniment of static, all too familiar to radio fans, is a sufficient proof of that.

But concerning the exact nature of the flash, its causes, its habits as to paths through the air, its preferred landing places, and similar matters, we remain in ignorance too dense to be enjoyed with equanimity.

That is what gives such great interest to the recent discovery of Mr. J. W. Legg, of the Westinghouse Electric and Manufacturing Company, who has made a new high-speed photographic camera and has used it to prove that flashes of artificial lightning, produced

The essential of the method is the use of alternating electric currents, of audio-frequency, which are fed into the ground at selected points and then detected by one method or another at points a short distance away. These currents tend, of course, to follow paths in the ground, which paths have higher conductivity than the general rocks of the earth.

Thus the currents will follow along veins or ore masses which are charged with conducting materials, including the minerals of iron. The details of recent results and methods in this direction were described by Mr. Hans Lundberg, of New York City, before a recent meeting of the American Institute of Mining and Metallurgical Engineers, and have now been published by that Institute.* Mr. Lundberg's paper is an informative description of the subject.

* Electrical and Electromagnetic Prospecting," by Hans Lundberg. *Transactions of the American Institute of Mining and Metallurgical Engineers* (New York City), volume 74, pages 3-28 (1926).

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from the high-voltage transformers in the Westinghouse laboratories, proceed through the air in spirals even more twisted than a corkscrew, and not in straight lines.* .

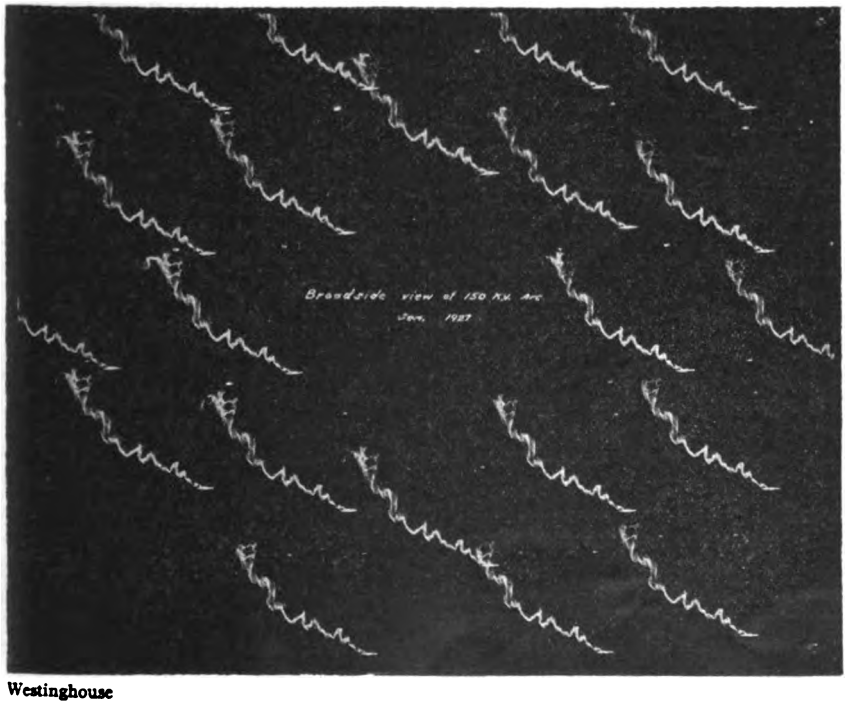
Mr. Legg's camera has twenty-two lenses, set in the front of a box which contains the sensitive photographic plate. In front of these lenses rotates a high-speed shutter which exposes each of the lenses in turn and for intervals which can be made as short as one twenty-six-hundredth of a second. Twenty-two separate pictures of a lightning flash or other object are made on the same plate, but eleven of these are in pairs, the two exposures of each pair being made simultaneously and on opposite sides of the plate. This makes each of these pairs stereoscopic. By cutting out the corresponding halves of each stereogram from the opposite sides of a print and mounting these in a special stereoscope Mr. Legg obtains a view of the flash which shows all three dimensions, looking "solid" instead of flat. This is how it was determined that the lightning moves in spirals, not in straight lines.

The camera was originally developed, not for tests of lightning, either artificial or natural, but for the study of arcs and sparks about electric machinery. When an arc forms across the terminals of a dynamo or motor, or in any other place around such machines, serious damage is apt to result. It is difficult to determine by mere inspection what actually happens in such instances of breakdown. The sparks occur far too quickly to be seen by the eye. After the arc is over essential parts of the machine or apparatus are likely to have been melted and to be indistinguishable. Purposeful breakdowns, artificially produced and photographed by some very high-speed camera, like that devised by Mr. Legg, are expected to yield much information of value in designing machines of this type.

Although the device does not appear to have been so used as yet, it is probable that it would be of similar service in studying the formation of arcs around radio apparatus or in the examination of sudden glows in radio tubes and of other radio phenomena the time-scale of which is extremely short. Especially in transmitters, such a high-speed photographic record of puzzling things that happen ought to be interesting and possibly important.

So far as lightning is concerned, the most interesting fact which emerges from Mr. Legg's proof of its corkscrew nature is the fact that it does not move in direct paths, determined by mere difference of potential or self-ionized by the spreading light wave which is emitted by the beginning of the spark and which undoubtedly precedes the spark. The real path, as disclosed by

*The camera and the spiral lightning flashes are described in a press release of the Westinghouse Electric and Manufacturing Company, of February 3, 1927; there is a more complete description by Waldemar Kaempfert in the *New York Times*, February 27, 1927, page 5 of the Special Features Section. POPULAR RADIO is indebted to the Westinghouse Electric and Manufacturing Company and to Mr. Legg for some further information.

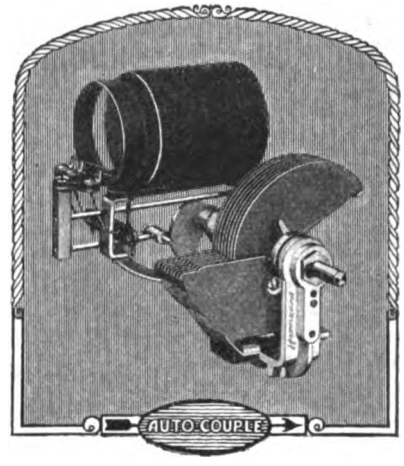


Westinghouse

WHAT PORTRAITS OF ARTIFICIAL LIGHTNING ARE LIKE

Here is a sample set of photographs of an electric arc, produced by a voltage of 150,000 volts. Each of the images on the plates represents one instantaneous photograph made by Mr. Legg's high-speed camera. Eleven of these images are in pairs, exposed at the same instant, but on opposite sides of the camera; these paired images are, therefore, stereoscopic.

A Better Tuning Unit Was Never Devised



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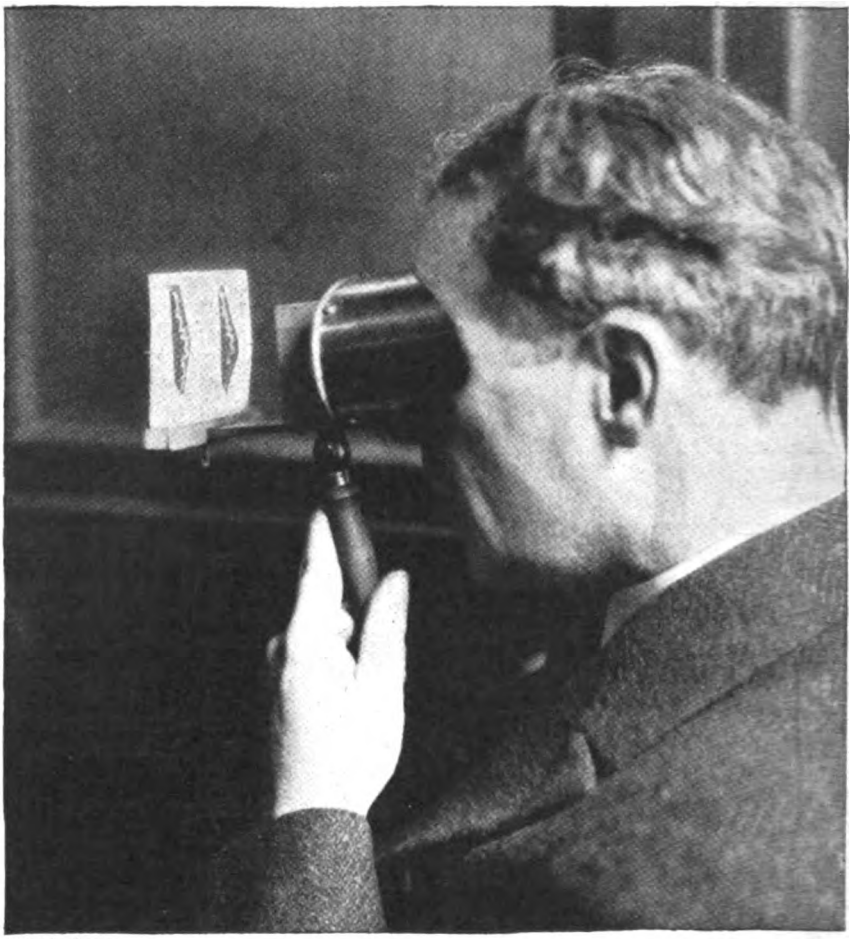

Westinghouse

EXAMINING A "SOLIDIFIED" LIGHTNING FLASH

The new high-speed camera perfected by Mr. J. W. Legg permits the making of stereoscopic photographs of an electric arc or of a flash of lightning. By mounting two such stereoscopic photographs in front of the lenses of a stereoscope, it is possible to view the portrait of the lightning flash as though it were solid. This is how Mr. Legg has discovered that the flashes of artificial lightning move in corkscrew fashion rather than in straight lines or in the zigzag lines by which lightning is conventionally represented.

Mr. Legg's stereograms, is perhaps determined by variable ionization of the air, making the true path of least electric resistance a winding corkscrew instead of some more regular curve. But all this is uncertain. What is needed, quite obviously, is some additional observation; including, if possible, the photography in the same fashion of flashes of real lightning in real storms. The Westinghouse Company promises that as much of this additional work as possible will be carried out.

The possible effects of ionization of the air on lightning, and the general desirability of investigating the whole matter further make it a good time to recall the interesting suggestion made some months ago by the veteran English physicist, Dr. C. V. Boys. Dr. Boys suggests that we should tempt lightning to come down when and where we want it to by shooting at it with a rocket.*

The hot gases escaping from the rear of the rocket would consist, Dr. Boys points out, of highly ionized materials. If it is really the ionization of the air which controls the path of lightning, the discharge of a good-sized rocket upward into a highly-charged thundercloud should be followed promptly by a stroke of lightning downward along the rocket's flight. Naturally, the experimenter would not care to touch off the rocket with a match. The danger of the cloud retaliating too quickly for successful flight away from the point of peril would be too great. But it would be possible, Dr. Boys suggests, to lie down on the ground at some distance and pull a string which would ignite the rocket.

The lightning season is approaching. It is to be hoped that some adventurous experimenter will put the matter to the test. If anyone does, both Dr. Boys and the Editor of this Department will be glad to hear of the results.

There is one precaution; the experiment should be tried at a distance from any buildings or inflammable materials. The fire department has enough trouble with natural lightning, without anyone going to the trouble of bringing some down on purpose to plague it.

* "Progressive Lightning," by C. V. Boys. *Nature* (London), volume 118, pages 749-750 (November 20, 1926).

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Instrument Layout

Here again you have an actual size print of each instrument and binding post and its exact location both on the panel and within the cabinet.

Wiring Diagram

The unusual feature of this Blueprint is that it is an actual size picture diagram of the finished set. Each instrument and other parts appear in exact size and the wires are so clearly traced from one contact to another that you can connect all terminals accurately without even knowing how to read a hook-up diagram.

Set No. 18—"*The Improved Raytheon Power-Pack*" (as described in the May, 1926, issue of POPULAR RADIO).
Set No. 19—"*The New Home Receiver*" (three tubes, two stages of radio-frequency-amplification with crystal detector, as described in June, 1926, issue of POPULAR RADIO).
Set No. 21—"*The Improved Browning-Drake Receiver*" (as described in the August, 1926, issue of POPULAR RADIO).
Set No. 22—"*The LC-27 Broadcast Receiver*" (as described in the October, 1926, issue of POPULAR RADIO).
Set No. 23—"*The LC-Senior Power-Pack*" (as described in the November, 1926, issue of POPULAR RADIO).
Set No. 24—"*The LC-Intermediate Power-Pack*" (as described in the December, 1926, issue of POPULAR RADIO).
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How to Build the Varion Power-Pack

(*Continued from page 454*)

and when it is finished the choke coil itself can be replaced and wired into the circuit.

In wiring up the transformer, A, be sure that the tagged leads are connected to the proper numbers, as shown in the picture wiring diagram in Figure 1.

A re-check of the wiring may be made by comparing the connections made on the unit with the connections shown in the schematic diagram in Figure 3.

When the wiring on the unit itself has been done, the extension leads to the switch, N, and attachment plug, M, and the receptacle, P, should be completed.

The wiring work is then complete and the top part of the metal case, Q, may be placed over and fastened with screws to the lower part of the case so that all of the parts are protected.

The power-pack may be used on 110-volts, 50 to 60 cycles. The valves to be used in the socket, F, are of the full-wave gaseous type, as mentioned earlier in the article. The rectifier valve should be inserted in the socket, F, and the plug, M, attached to the lighting lines, first being sure that the switch, N, is turned off before the unit is connected to a receiver.

The connections to the receiver should be made with a battery cable and will depend on the type of receiver that the unit is used with. As the binding posts are all marked with the voltages that will be obtained, this should be a simple job to do.

The detector-plate voltage may be varied by rotating the knob on the potentiometer, J2, and the "C" bias to the last tube in the set may be varied by rotating the knob on the potentiometer, J1. No other controls or adjustments are necessary. The unit should work satisfactorily with any receiver, provided the proper connections are made so that the voltages designated by the manufacturer of the set are obtained.

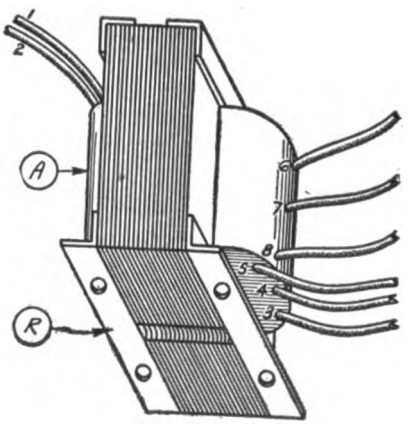
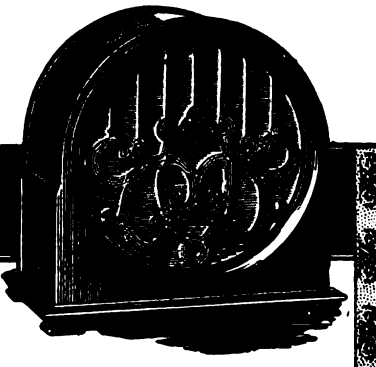


FIGURE 8: *This drawing shows how the transformer leads are numbered and indicates the proper way to fasten the brass brackets to the core.*



Amplion Cone

Cabinet Model A C 12 . . . $30

Even the best radio set depends on the *reproducer* for its quality of tone.

In every test or comparison, the Amplion Cone quickly demonstrates how much the quality of reception is improved by this fine instrument.

Especially vocal broadcasting

—the supreme test of a radio reproducer. With an Amplion Cone, *all* reproduction sounds natural and distinct.

Other Amplions from $12 to $135

Write for Amplion literature which illustrates and describes all models

THE AMPLION CORPORATION OF AMERICA

Dept. X, 280 Madison Avenue, New York City

THE AMPLION CORPORATION OF CANADA, LTD.
Toronto, Ontario

AMPLION

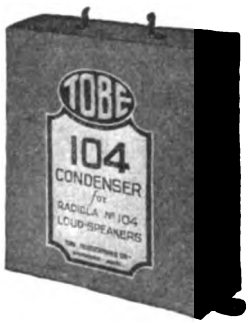
TOBE

Trade Mark Reg'd U. S. Pat. Office

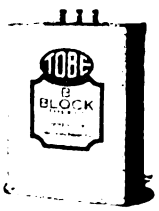
Tinytobes

The TINYTOBE Condenser, shown in actual size above, is a new product and is available in capacities from .00007 to .02 Mfd. For continuous operation at voltages up to 1,000 volts D. C. It is so small and light that it can be soldered directly into the circuit without other support.

Prices range from 35c for .00007 Mfd. to 60c for the .02 Mfd.



A special-purpose condenser made for the Radiola No. 104 Loud-Speaker, and made to stand up in continuous use. It fits the space provided. Price, $7.00.



The first condenser B-BLOCK specifically designed for use with the Thordarson Power Compact Type R-171 is the TOBE B BLOCK Type R-171. The terminals are arranged so that they come close to those on the Thordarson Power Compact, for minimum time and length of wiring. Short-path, non-inductive condensers are used for increased efficiency. The price is $12.00.

Thordarson makes a 210 unit also, and there is the TOBE B BLOCK Type R-210 to go with it. Price, $13.00.

The TOBE 600 Line

High-voltage condensers for AmerTran and similar high-voltage packs. Big, husky 1,000-volt D. C. continuous-operating voltage condensers—made to stand the gaff. Equipped with TOBE safety terminals.

PRICES

No. 650—0.5 Mfd. $2.00
No. 601—1.0 Mfd. 2.50
No. 602—2.0 Mfd. 3.50
No. 604—4.0 Mfd. 6.00

Write us for information on the TOBE Radio Interference Filters. They are made to reduce *man-made static.* Ask for Pamphlet L-5.

Tobe Deutschmann Co.

Engineers and Manufacturers of Technical Apparatus

Cambridge, Mass.

How to Eliminate Interference With the Pre-Selector

(*Continued from page 443*)

is connected direct to the receiver and the Pre-selector is cut out of the circuit.

Operation of the Pre-selector

After the Pre-selector has been connected to the receiver, batteries and antenna it is ready to be put into operation. First see that the rotors of the two plug-in coils are turned so that their windings are parallel with those of the stators. Also see that the midget condenser on the panel is set with its plates half-meshed.

Now set the tuning dials of the receiver to some wavelength *above* the broadcasting band. The tuned circuits of the receiver will function as fixed tuned circuits after the Pre-selector is put into operation. It is important that these circuits be tuned to exact resonance with one another. Probably the best way to accomplish this is to set them at the highest wavelength at which the receiver has been logged, say the wavelength of KYW if this station has been logged on the receiver. After the Pre-selector is functioning, this setting may be changed to a higher wavelength, following the directions given below.

Next, turn the receiver "on" and turn the rheostat of the Pre-selector up (¼ way if the filament supply is 6 volts, or about ¾ way if the "A" supply is 4½ volts). Then, tune in a station on the two dials of the Pre-selector.

Wave-length	*Left-hand Dial*	*Right-hand Dial*
235	26.5	27
244	28	28
263	32	30
273	34	33
300	40	42.5
309	42	45
330	46	51
360	52.5	60.5
391	58.5	69.5
431	64.5	79
447	66	80
475	70	87.5
492	71.5	92
526	74.5	96

The dial settings shown in the tabulation above will give an approximate idea of how the settings run, but will not necessarily be accurate for all Pre-selectors because the setting of the left-hand dial of the Pre-selector will vary with the wavelength to which the receiver is tuned.

When a station is heard, it should be tuned in as loud as possible on the two dials of the Pre-selector. Then turn back to the receiver and readjust its dials for maximum reception. The receiver circuits will then be in resonance.

The receiver may now be adjusted for a higher wavelength. Turn the left-hand dial of the Pre-selector a fraction of a degree higher until the station can just barely be heard. Then again readjust the receiver dials for maximum response. Continue this manipulation until the receiver is adjusted for the highest wavelength to which it is capable of tuning. Thereafter the tuning controls of the receiver require no further attention. A little experimentation will be needed to determine the best settings of the rotors of the coils, the rheostat, and the midget condenser in the Pre-selector. Usually the best setting of the rotors of the coils will be that with the rotor windings at an angle of about 45 degrees from the stator windings. The rheostat should be set at the lowest point at which maximum volume can be obtained. This will be at about ¼ turn of the knob from the "off" position.

The adjustment of the midget condenser is only important in tuning in distant stations. For all ordinary reception it may be set at one place and left there. In experimenting with the setting of the midget condenser it is important to remember that any considerable adjustment here will require a readjustment of the right-hand tuning dial of the Pre-selector.

If the receiver has two or more antenna terminals, it is advisable to try connecting the Pre-selector to each of them in turn. Usually results will be best if the output wire from the Pre-selector is connected to the "short antenna" binding post of the receiver. In making these tests it will probably be found necessary to readjust slightly the dial which tunes the antenna circuit of the receiver.

In putting the Pre-selector into operation it is well to remember that it is an extremely sharp tuning device, particularly on the left-hand dial. Even the most powerful local stations may be tuned out by a slight movement of this dial. The right-hand dial is also quite critical in tuning (although this varies somewhat with the position of the rotor of the right-hand coil), so that a station will not be heard unless both dials are quite accurately adjusted to the proper setting for the station tuned in. To locate stations for the first time it is advisable to proceed by setting the right-hand dial at 40 and then slowly rotating the left-hand dial between 20 and 60. If nothing is heard, move the right-hand dial to 45 and rotate the left-hand dial between 25 and 65, etc.

If the frequency changer tube of the Pre-selector oscillates (this condition is indicated by numerous whistles as the right-hand dial is turned) to such a degree that the midget condenser does not offer sufficient control, the remedy will be found in replacing fixed condenser C5 with one of higher capacity, say .00015 or .0002 mfd. The use of

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TO THE RADIO INDUSTRY

An announcement of interest

THE Ward Leonard Electric Company has built nothing but resistance apparatus for more than 35 years.

Today it offers the Vitrohm Resistor as the solution to your radio resistor problem.

Ward Leonard wants the business of manufacturers who are giving to the public good apparatus that will work and keep on working.

The Vitrohm Resistor is a wire-wound, vitreous enamelled unit that will not alter in value during service nor disintegrate under constant use and heavy loads.

Ward Leonard has made this type of Vitrohm Unit for more than 35 years, and as is usually the case, skill and methods have improved with practice.

Ward Leonard maintains a staff of trained engineers and technicians with all of the resources of well equipped laboratories to aid them in their work. For more than 35 years they have endeavored to find something "good enough" to replace the vitreous enamelled wire-wound Vitrohm Unit. And after 35 years they are still trying, but no equivalent for Vitrohm has been found.

The Radio Industry has become a large, though youthful, factor in the Electrical Industry. It is finding that this is an industry which ever demands the best. In the Electrical Industry "best" in resistors means Vitrohm.

To the radio manufacturer who wants the best, to the man who insists that everything he buys be dependable in quality and sure in production, we say, "Come to our plant. See us work. See our facilities and learn why only Ward Leonard can give you the Vitrohm Resistor".

The prices of Vitrohm Resistors for radio are not high. While they cannot enter into price competition with molded "mud" or makeshift units, they are cheaper on a dollar basis than any other unit which even approximates their performance. And they are Vitrohm *dependable* Resistors.

"RESISTOR SPECIALISTS FOR MORE THAN 35 YEARS"

Ward Leonard Electric Company

37-41 South Street Mount Vernon, N. Y.

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HERE IT IS!

Marvelous Townsend "B" ELIMINATOR (Complete) only $4.95 $1.00 Down Balance C.O.D.

Direct from Factory

10 Days FREE TRIAL You are the Judge!

at lowest price on record

Here is great news! For half the price of a set of "B" batteries you can now enjoy greatly improved reception and be done forever with the nuisance of recharging and renewing unreliable "B" batteries. We make every part that goes in the Townsend "B" Eliminator in our own factory. That's the reason we can give it to you at such a low price—give you a high quality instrument backed by a real guarantee. Users report splendid results. A fine "B" Eliminator at the lowest price on record. Our 10 days Free Trial proves it.

MONEY BACK

if not amazed and delighted

You alone are the judge. We could not afford to make this guarantee if we were not sure of the Townsend "B" Eliminator's splendid performance. Just plug into your electric light socket and in a moment you will realize what good reception means. Delivers up to 100 volts on any set, on direct or alternating current—any cycle. Gives full wave rectification. Full tone, clarity and volume—uninterrupted by screeches of fading batteries.

REPORTS SATISFACTION

Alexandria, Ind.

Enclosed find check for which please send us two Townsend "B" Eliminators.

I am using one of your Eliminators on a Reflex set that a well known "B" Eliminator costing $27.50 would not operate. H. Fred Carey.

The Townsend "B" Eliminator is completely enclosed in a heavy steel case with beautiful lacquer finish. Handsome in appearance—satisfactory in operation.

Rush Order Today!

Simply fill out the coupon and slip it into an envelope with only $1.00. Get it into the mail at once. Your "B" Eliminator will be sent you promptly by return mail. Deposit $3.95 only with the postman. Try out the Eliminator for 10 days — then if not astonished and thrilled by improvement in operation, return it to us and purchase price will be refunded in full. You don't need to put up with battery nuisance another day when it is possible to own a "B" Eliminator at this startlingly low price. Send for it today.

TOWNSEND LABORATORIES

713 Townsend St. Dept. 19 Chicago, Ill.

Attach Only $1.00 to this Coupon

TOWNSEND LABORATORIES
713 Townsend St., Dept. 19, Chicago, Ill.

Gentlemen: Attached find $1.00. Kindly send at once Townsend "B" Eliminator, C. O. D., for $3.95, plus postage, on guaranteed 10-day free trial.

Name.....

Address.....

City.....*State*.....

.00025 mfd. capacity here will usually prevent oscillation entirely and for that reason may be preferred by some builders for the set-up.

Operation of the Pre-selector with a Loop Antenna

A receiver that employs two stages of tuned-radio-frequency amplification will give good results when operated with a loop, in conjunction with the Pre-selector. With the experimental model of the Pre-selector a loop antenna has brought in stations up to 400 miles distant, when used in a poor location, with a number of different standard makes of 5-tube receivers.

To connect the loop, disconnect the antenna from the Pre-selector and remove the right-hand coil (looking from the front) from its socket. One end of the loop is then connected to terminal No. 3 of this coil socket. The other end of the loop is connected to terminal No. 6 and the center tap of the loop is connected to terminal No. 4 or No. 5 (these are connected together in the wiring of the Pre-selector).

If the loop does not have a center tap, it is a simple matter to scrape the insulation off a spot at about the middle of the loop winding and to attach the connecting wire from the Pre-selector at this point. It is advisable to keep the three leads from the loop to the Pre-selector as short as possible, and to bring them out at the rear of the Pre-selector unit so as to keep them well away from the body of the operator. The tuning process is accomplished in the same manner as when an antenna is employed.

The Latest Experiments with Television and "Black Light"

(*Continued from page 451*)

and had a bad effect on the eyes of the sitters. So I went to the other end of the spectrum and tried infra-red rays. By means of these latter rays I was able ultimately to dispense altogether with visible light, with the somewhat remarkable result that it was possible to *see in total darkness!*

This is perhaps the most spectacular development of all in connection with television, and it has an uncanny and impressive effect upon visitors to a demonstration. The sitter goes into the transmitting studio and is immediately enveloped in complete darkness. Literally, he cannot see his hand in front of his face, but his friends at the receiving end are able to see him put his hand up in an effort to see it.

On December 30th, 1926, a demonstration was given to members of the Royal Institution and a description of what was shown appeared in *Nature* on February 5th, 1927; the account was written by a witness, Dr. Alexander Russell, F. R. S., Principal of Faraday House, London.

It is unwise to prophesy what may be the full extent of the importance of this development in warfare. It may even render it possible to follow the movements of an enemy when he believes himself to be under cover of darkness.

Darkness, the great cloak for military operations, will no longer give so much security. The attacking party creeping forward for a surprise attack on a pitch-black night may be swept by an invisible searchlight, and watched on the television receiving screen of the defenders. Allowed to come well within range and in spite of the apparent protection of darkness and the absence of visible searchlights, they may find themselves overwhelmed and decimated by well-directed gunfire.

It is to be hoped, however, that other uses may be found in peace time for this latest development of television. The fact that infra-red rays possess great fog-penetrating powers opens up possibilities for their use in connection with naval warfare and commercial navigation.

The power of light to penetrate fog varies roughly as the fourth power of the wavelength, so that red light penetrates some 16 times better than blue light, and infra-red light some 16 to 20 times better still.

Red light has already come widely into use in aerodromes, and for other purposes where fog penetrating properties are of importance. This new application of television renders possible the use of infra-red rays with their great penetrative powers.

These invisible rays are employed in exactly the same way as ordinary visible light. That is to say, the rays are allowed to shine on the sitter, and the "light" reflected from his face is passed on to the infra-red "televisor."

As to the distance over which television impulses may be transmitted, any circuit which will transmit clear speech, either by wire or by wireless, is suitable. Given any such circuit, however long, it is possible to send television impulses over it.

That being so, and as we now have direct telephonic communication between London and New York by a combined wire and wireless link, we may, perhaps, look forward with confidence to the day when New Yorkers will be able to see what is going on over 3,000 miles away in the great British metropolis, just as they are now able to hear.

The enormous possibilities of television stir the imagination, and open up long vistas crowded with marvelous speculative visions and achievements surpassing even those which the fabled Magic Carpet made possible.

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"8 hour" SERVICE on any Kit or Parts

The most complete stock of QUALITY KITS and PARTS in the CENTRAL WEST enables us to offer this unheard of service. Only GENUINE parts specified by designers are used—NO SUBSTITUTIONS—All quality Parts and Kits are stocked—even those not listed below. Any item advertised in this issue obtainable here at quoted prices. WESTERN READERS are now assured of quicker service. Send your orders for quality merchandise and pleasing, rapid service.

Pre-Selector Receiver	$ 32.20
Hammarlund-Roberts Hi-Q	63.85
Varion Power Pack	55.00
Silver Shielded Six	55.00
S-C II Receiver	63.85
New Browning Drake	95.45
L-C 27 Receiver	85.20
L-C 27 Senior Power Pack	63.85
L-C 27 Intermediate Power Pack	47.60
B-T Power Six	78.13
New Remler Infradyne	112.35
Karas Equamatic	80.24
New Samson (Cotton) Super	135.00
Clough Super	63.85
R-G-S Receiver	60.70
Chicago Daily News Receiver	46.30
Worlds Record Portable Super (complete)	155.00
Centralab Tone Amplifier	16.00
CeCo Tubes (as advertised)	1.75 up
S-M 652 Reservoir "B" (Less Tubes)	34.50

Send only $5.00 with your order and we will ship within 8 hours any kit or part on the market—you pay balance upon delivery, plus small mailing charges. All Delivery Charges PREPAID on any kit, anywhere in the U. S., IF certified check or money order for full amount accompanies order. Prices on complete wiring of kits gladly given. SEND IN YOUR ORDER—we Guarantee real service and merchandise.

AUSTIN-WHITE
RADIO
125-7 S. Market St., Chicago, Ill.

BUILD THE SPEAKER COCKADAY DESCRIBED

Costs less than a small cone speaker and 1/5 as much as a factory-built 3 ft. cone

Enjoy *all* of your radio. Hear those real low notes your present speaker cannot reproduce; mellow those high notes which are near-shrieks; get *every* frequency clearly and distinctly.

Build this marvelous PENN 3 ft. Cone Speaker in one evening and save 4-5 the cost of a factory-built 3 ft. cone speaker. This is the Original DOUBLE CONE "build-your-own" 3 ft. Speaker.

"I have built 6 of your 3 ft. cone speakers and have never heard anything so wonderful. I have no trouble making them," says Karl Tuarski, Chicago.

"Heard instruments in a selection I had never heard over the radio; I heard ALL the band," writes Leslie Roberts.

Operates on All Voltages

Whether you use 90, 135, 180 or up to 450 volts the PENN 3 ft. Cone Speaker operates at the maximum efficiency of your set.

The wonderful PENN C. S. Unit has full 16 oz. horseshoe magnet, udalyted to prevent rusting; super-magnetized; adjustable to output of any set; shortest, strongest drive rod; straight-line drive. Armature cannot lock; coils cannot burn out. Unit only, $9.50.

Endorsed by such radio authorities as Cockaday, Harkness, Hurd, Casey and many others.

Parts Complete, $14.15

including PENN C. S. Unit, 2 shts. gen. FONOTEX, pr. PENN Back Rings, set PENN Unit Mountings and spc. AMBROID Cement. Nothing else to buy.

Ask Your Dealer

Insist on genuine PENN parts—the *original* "build-your-own" DOUBLE 3 ft. Cone Speaker. If he hasn't genuine PENN parts and will not get them for you, we'll ship direct, f. o. b. N. Y. C., on receipt of price. Do not accept substitutes.

PAMPHLET—*"How to Build a Giant 3 ft. Cone Speaker"* sent for 10c, coin or stamps. Write today.

PENN RADIO SALES CO.
104 Fifth Avenue Suite 2057A New York City

Some of the Extraordinary New Tubes

(Continued from page 460)

or, if the valve is arranged to oscillate in its normal condition, the applied speech will automatically modulate the CW output and act as a radio telephone transmitter.

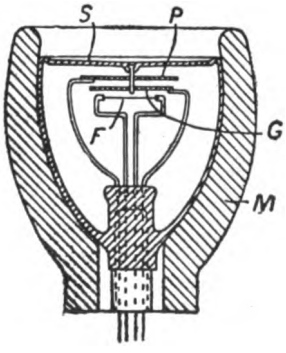
A Tube That Contains a Resistance-Capacity Coupling

Another outstanding development in unusual thermionic vacuum value design is credited to Dr. S. Loewe of Berlin, whose devices have already been described in these pages. He has succeeded in designing a resistance-capacity coupling of such minute dimensions that instead of applying it to the circuit externally, he is able to incorporate it within the bulb of his valve. This valve, also, has two sets of electrodes, so that the complete device acts as a two-stage low-frequency amplifier, and is all included within a single small bulb.

Such a tube will give the same degree of amplification as two ordinary resistance-capacity-coupled low-frequency amplifier stages, externally coupled in the usual manner; and, owing to the elimination of parasitic capacities and long external leads, it is particularly suitable for use as a high-frequency amplifier, particularly on short waves, although the high-frequency amplification obtainable by means of resistance-capacity coupling is not as great as in a tuned amplifier.

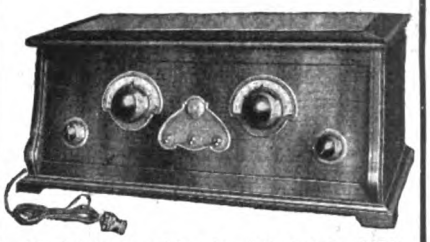
From the few examples of unusual tube design here mentioned it is apparent that we have by no means exhausted the possibilities of thermionic vacuum valves.

It is evident, however, that if we can once get out of the rut, there are almost limitless possibilities for radical changes to be made in our methods of applying the principle of the thermionic vacuum valve—changes which will permit us to employ the principle for our special requirements more economically or more efficiently than at present.



A TUBE THAT ACTS AS A MICROPHONE

FIGURE 5: *Notice that the diaphragm, S, vibrates, in this way changing the distance between the electrodes.*



Model T-2—with six AC Tubes—$225

Hear the new MARTI *Electric Power* RADIO

Current Direct from Light Socket to Receiver

Equipped with Six McCullough Tubes

Current direct from your electric-light socket to your Marti receiver! No A or B batteries, no trickle charging, no eliminators; just plug into your house current and the Marti receiver is ready to play.

The Marti is equipped with six long-life McCullough tubes.

Hear the Marti at your earliest opportunity. Ask your dealer for a demonstration.

Model T-3
with six AC Tubes—$225

Marti Electric Radio Co., Inc.
22 Central Ave., West Orange, N. J.

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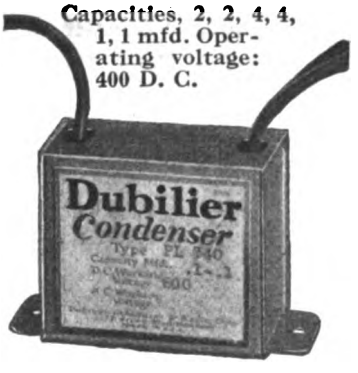
Dubilier
Condenser Block
TYPE: PL-381
as specified in May RADIO BROADCAST

Type PL-381 condenser unit has been selected by Radio Broadcast because of its long life and general adaptability. It is the ideal eliminator condenser because of the improved dielectric material used. Each unit must withstand severe tests in order to pass our rigid inspection standards. Dubilier high-quality workmanship and reputation protect your investment and eliminate trouble.

NOTE THE FLEXIBLE, RUBBER-COVERED LEADS and convenient mounting tabs. Metallic containers protect condenser elements from moisture and mechanical injury.

Capacities, 2, 2, 4, 4, 1, 1 mfd. Operating voltage: 400 D. C.



—and now DUBILIER BUFFER Condensers

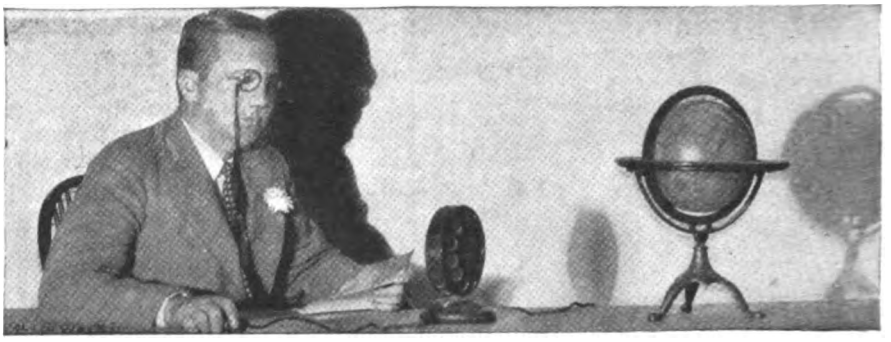
For satisfactory service using the Raytheon rectifier tube, the new Dubilier buffer condenser is absolutely essential. Made of two .1 mfd. condensers electrostatically shielded from each other and from external capacity effects. **FLEXIBLE, RUBBER-COVERED LEADS.** Metallic containers with mounting tabs. Two types: **PL-91** for 400 volts D. C.; **PL-840** for 600 D. C. volts.

At All Dealers

WRITE FOR BOOKLET:

A new booklet, "17 Ways to Improve Your Set," will be mailed on receipt of ten cents. Tells how to use fixed condensers and gives circuit details. Be sure to get your copy.

Dubilier
CONDENSER CORPORATION
4377 Bronx Blvd., New York City



BROADCASTS

Transmission Tests on Sets Ten Miles in the Air

JUST what radio reception may be when the signals are transmitted from a great height—possibly ten miles—may be determined by the experiments of two French aeronautical experts this spring. They have arranged to send up a small balloon, which will carry with it a very light radio set that will automatically send out signals. From a like set signals will be sent at the same time from the ground. The signals from both sources will be carefully recorded and compared with one another.

From the experiment it is hoped to obtain information regarding the effect of atmospheric conditions on the transmission of radio waves that will aid both aviation and radio.

* *

An "Automatic" Radio Operator

A RADIO signaling device to take the place in emergency of a ship's operator is the latest contribution to the radio art. It has been developed by Lieut. Pedro C. Andux of the Cuban Navy. Lieut. Andux says that the tests of his invention show that anyone can manipulate the device and that it provides ships with a means of sending distress signals without the necessity for a trained operator. The entire radio set, with batteries and automatic signaling device, weighs about fifty pounds.

* *

$1,000,000 Paid on a Signature Sent by Radio

ONE of the practical services that radio is rendering to business was told in a recent news item in the New York *Times*, which reported that payment of $1,000,000 had been made on notes presented at the Bankers' Trust Co. of London on March 1. The Mellon National Bank of Pittsburgh advised payment for its client, but it developed that the London organization was without a specimen of the signature on the note.

"There was no time to cable or mail the signature," the vice-president of the Mellon bank said. "Only one thing was left—wireless. We had the President and Treasurer of the business house we represented sign cards, which were sent to New York, from where they were sent yesterday across the ocean."

The Bankers' Trust Company at London received the signatures, compared them with the note and paid the $1,000,000, charging the Mellon account.

* *

A New Record in Chain Broadcasting

THE largest chain of radio stations ever joined together for simultaneous transmission of any event were linked February 22d by the National Broadcasting Company to carry the voice of President Coolidge from the House of Representatives in Washington to the radio audience of the United States. Forty-two stations were included in this record event.

* *

A Unique Contest for "Program Property Rights"

THE long expected fight over the property rights of programs broadcast broke recently when station WEAF of New York protested the action of the St. Paul Program Service Company in "tapping" or rebroadcasting WEAF programs by means of telephone wires. The company picked up the programs from WCCO, one of the WEAF chain stations and sent them out to over 1,000 subscribers whom they charged $5 a month for a loudspeaker connection with the telephone switchboard. Although the Program Company has discontinued the rebroadcasting of WEAF programs as a result of this protest, they are continuing to "tap" programs from other stations.

* *

A Radio Magazine for the Blind

A FRENCH publisher is now issuing a radio magazine for the blind. It is reported that the publication is being printed in Braille raised type.

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A Test of Telepathy by Radio

WHEN the Society of Psychical Research in London recently undertook to conduct a practical test in thought transference from a broadcast station "to determine if it would be possible for persons cut off from communication with the outside world to get their thoughts across to persons listening in on radio sets," it was deluged with 25,000 letters from radio fans who participated in the experiment. These replies are now being studied; when this task is completed, Sir Oliver Lodge, who conducted the test, will report his findings in a speial article for POPULAR RADIO.

* *

"Bootlegging" Radio Messages

RADIO is not unknown to gamblers as a tool for carrying on their illicit activities. But it has remained for an ingenious fan in New Orleans to "bootleg" a small portable transmitting set into the Jefferson Park race course, presumably for the purpose of sending out information or the racing results to associates who could take advantage of the information. He was taken in custody by Federal authorities on the charge of violation of the law prohibiting broadcasting of public events without a license.

Incidentally, the winner of the last race was named Radio.

* *

Radio Saves the Whaling Industry

RADIO has now become a part of the equipment of the present-day whalers in the waters around the South Polar Continent. That part of the ocean is now the world's great whaling ground, as these animals have been virtually exterminated in the more accessible oceans of the northern hemisphere. In the days when New England held supremacy in whaling, the signaling of the presence of a victim was accomplished only by such familiar short-range means as flags or guns; nowadays the South Atlantic whalers carry radio sets. The movements of the whales may be reported to other ships of the fleet as far away as a thousand miles. The whaling fleets now provide a single ship for the rendering of the oil and the preparation of the flesh for cattle food, fertilizer or other salable products; this ship also carries radio apparatus and may be summoned by the faster ships of the killing fleet to any part of the ocean where a kill has been made. Were it not for the use of those and other modern scientific devices it is doubtful if the whaling industry could survive at all, now that other materials have taken away the former high-priced markets for the whale oil and other products.

First in the Field Specializing in Cockaday Kits

S. HAMMER RADIO CO., 303 Atkins Ave. Brooklyn, New York

Cockaday Sets Now Made Easier to Build by Our New "Ready-to-Wire" Plan

50% of Your Time, Work and Worry SAVED!

All you need do is to connect bus-bar according to diagram, solder and your set is finished. These Kits are sent to you completely mounted, and assembled on a Veneered Mahogany baseboard and genuine bakelite panel, drilled and engraved. Genuine parts used as listed below; exactly as used in Mr. Cockaday's Laboratory Model. COMPARE OUR OFFER!

LC-27 BROADCAST RECEIVER

SENIOR AND INTERMEDIATE POWER PACKS

1 Hammarlund mid-line dual condenser, .000275 mfd.	$ 7.50
1 Hammarlund mid-line single condenser, .000275 mfd.	4.65
1 Precision Duo-Octoform coil set comprising one antenna coupler and two interstage couplers	10.50
1 Amertran De Luxe first-stage transformer	10.00
1 Amertran De Luxe second-stage transformer	10.00
1 Amerchoke #854	6.00
1 Dubilier or Tobe 4 mfd. Filter condenser.	5.50
1 Dubilier filter condenser, .1 mfd.	.60
1 Mar-Co illuminated control scale 0 to 100	3.50
2 Mar-Co small controls, scale 0 to 50 and 50 to 0	1.50
1 Carter Battery Switch	.65
1 Samson radio-frequency choke coil #85	$1.50
3 Aerovox, mica fixed condensers, .00025 mfd	1.05
1 Durham or Daven Resistor 4 meg.	.50
1 Lynch Grid Leak Mounting	.35
1 Carter Gem Jack	.25
1 Carter variable resistance, 0-10,000 ohms.	2.00
12 Eby binding posts	1.80
5 Benjamin UX Sockets	3.75
1 Amperite No. 1	1.10
Mechanical Kit, consisting of aluminum shields, binding post strip, decorated panel and Tait brackets	12.50

READY-TO-WIRE KIT PRICE $85.20

LC-27 SENIOR POWER PACK KIT $65.20

LC-27 INTERMEDIATE POWER PACK KIT $47.50

SILVER SHIELDED SIX KITS *In Stock Now!*

HAMMARLUND-ROBERTS HI-Q RECEIVER

3 Sets of Hammarlund AutoCouple Coils	$10.00
3 Hammarlund Mid-line Variable Condensers	14.25
1 Hammarlund Jr. Variable Condenser	1.80
1 Sangamo Condenser with clips .00025 mfd.	.40
1 Durham resistor, 2 megohms	.50
1 Sangamo Fixed condenser, .001 mfd.	.50
2 Samson low-frequency transformers	10.00
1 Carter Snap Jack, No. 1	.25
1 Carter combination battery switch and 10 ohm midget rheostat, No. M-10-S.	1.00
2 Amperites No. 1A	2.20
1 Amperite No. 112	$ 1.10
1 Carter "Imp" antenna switch No. 12	.70
3 Benjamin sockets No. 9040	2.25
2 Benjamin sockets without bases No. 9049	1.00
2 Marco Vernier Dials No. 192	5.00
10 Binding posts	1.50
1 Hammarlund-Roberts foundation unit	10.50
1 Fixed resistance, 2 ohms	....
2 Hammarlund Equalizer Condensers	....
PRICE INCLUDED IN ABOVE UNIT	

READY-TO-WIRE KIT, PRICE $63.05

The Above Kits Can Also Be Obtained Completely Wired to Specifications
Write for our interesting special circular which we have prepared on the LC-27 Receiver and above Kits
DEALERS: WRITE FOR SPECIAL DISCOUNTS

New!

"The Talk of the Radio World"

TYPE "K" Radio Frequency Tube

Price, $3.00

EC
TYPE "K"
will pep up your set, increase volume, improve the tone, clarify distant reception
The Tube of Longer Life
A Type for Every Radio Need

Makes a Good Receiver Better
Write for Complete Data Sheet
C. E. MFG. CO. Inc. . . . PROVIDENCE . R. I.

Announcing

the first of a series of new models of

TIMBRETONE

REG. U.S. PAT. OFF.

Combined with the utility of a smoking stand is a loud speaker. Carry it about and have it where you want it—on the porch or alongside of your easy chair.

Sales offices

SANFORD BROS.

CHICAGO . . . . . 30 W. Walton Pl.
CHATTANOOGA . . . 615 Broad Street
SEATTLE . . . . . Am. Bank Bldg.
SAN FRANCISCO . . 311 Minna Street

Factory: TIMBRETONE MFG. CO. Hoosick Falls, N. Y.

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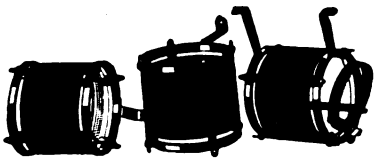
Use These Coils and Improve Any Radio Receiver

AERO COIL
SUPER-SENSITIVE
INDUCTANCE UNITS



Tuned Radio Frequency Kit

$12.00

This Aero Coil Tuned Radio Frequency Kit will positively improve the performance of your receiver. It is the basic reason for the splendid performance of the 5-tube Aerodyne Receiver described in this issue of POPULAR RADIO. Special patented Aero Coil construction eliminates radio freqency losses. You will notice instantly a tremendous improvement in volume, tone and selectivity.

This kit consists of three matched units. The antenna coupler has a variable primary. Uses .00035 condenser. Coils are uniformly air spaced. No dope is used. Consequently they tune into resonance on a "knife's edge."

FREE with Each Kit

Eight-page color circuit, layout and instruction sheet for building the super-sensitive 5-tube Aerodyne Receiver, described in this issue, packed with each kit. Extra copies, 75c each. Instructions include insert showing how to wire up for a power tube if desired.

Get these coils from your nearest dealer. If he can't supply you, order direct from the factory.

AERO PRODUCTS, INC.
Dept. 104 1772 Wilson Ave.
CHICAGO, ILLINOIS

A Unique Broadcast Program for Charity

NEARLY 5,000 radio fans attended the benefit performance staged by the Chicago Broadcasters Association at Rainbow Gardens, Chicago, on February 28. Artists from the eleven stations that make up the association appeared and individually put on the acts which have endeared them to the listeners. The proceeds of the benefit are to be expended in continuing the charity work among broadcast artists. In addition to caring for radio artists in need of assistance, the association has helped nearly a score of needy musicians with sums varying in amount from $100 to $150 dollars each.

* *

Why This Will Be a Good Summer for Radio

ACCORDING to all predictions, this summer will be "the best summer radio has ever had."

In the first place, summer static has been dealt a staggering blow by the general increase in power. Formerly almost any kind of radio reception was hopeless during the summer months, but it was found by increasing the power that much could be done to overcome the discordant element.

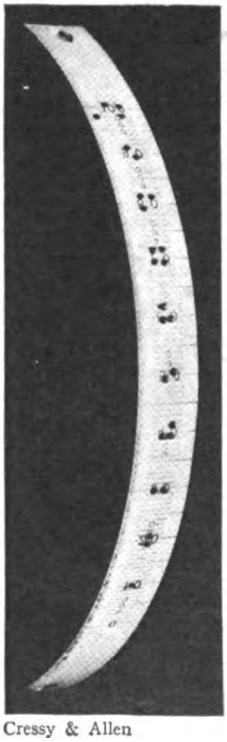
In the second place, so rapid has been the increase in the number of large stations that almost every principal city now has one, and the residents there and in the suburbs can now depend upon that station at least. There are perhaps no more pesky summer conditions in any two cities in the country than Washington, D. C., and St. Louis, for instance, yet in both of these cities radio listeners are now as well served with good programs in the summer as the winter, and so far as their own city station is concerned they hardly know what static is. And this example could be repeated in many other parts of the country.

In the third place, the fans this summer may expect additional relief in the way of clearing up and stabilizing air conditions by the new radio commission.

* *

1,000,000 Farmers Listen In on Broadcast Market Reports

NINETY-FIVE radio stations in 35 States now are broadcasting Government crop estimates and market reports over the country, as shown in a list of broadcasting schedules, issued by the Bureau of Agricultural Economics, United States Department of Agriculture. This list includes most of the leading broadcasting stations. Arrangements for broadcasting daily market reports have been made by the bureau with local radio stations in every important market center where Government market news work is conducted. Government market reports, it is estimated, now are made available immediately to more than a million farmers.



Cressy & Allen

TUNING IN BY THE TOUCH SYSTEM

In this receiving set, at the Maine Institute for the Blind, the ordinary dial has been replaced by one marked with the Braille system of raised type; the tuning strip is shown at the left. At the right, Everett Astel, a mechanic at the Institute, is pictured while reading the dial with his left forefinger.

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Changes in the List of Broadcasting Stations in the U. S.

During the month of March, 1927, the following changes were reported in the list of broadcasting stations:

STATIONS ADDED

KEX	Portland, Oregon	447.5
KGFN	Aneta, North Dakota	222.1
KGFP	Mitchell, South Dakota	283.0
KRLO	Los Angeles, California	448.9
WGOC	Columbus, Mississippi	285.3
WNBO	Washington, Pennsylvania	215.0
WNBQ	Rochester, New York	407.6
WNBR	Memphis, Tennessee	316.9

CHANGES IN CALL LETTERS

KGFA	Seattle, Washington	*change to*	KTCL
KGEX	Muscatine, Iowa	*change to*	KPNP

CHANGES IN WAVELENGTHS

KFXB	Los Angeles, Cal., 202.6	*change to*	352.7
KGCW	Chickasha, Okla., 252.0	*change to*	270.1
KUT	Austin, Texas, 230.6	*change to*	272.6
WHT	Deerfield, Ill., 238.0	*change to*	399.8
WJBY	Gadsden, Ala., 260.0	*change to*	270.1
WKBF	Indianapolis, Ind., 244.0	*change to*	243.8

* *

Radio Message Delivered by the Milkman

JUST before starting on his early morning deliveries, H. C. Jenson, a milkman of Hartford, Connecticut, makes a practice of listening in on his broadcast receiver. Recently, he tuned down to the amateur phone stations on 150 meters and was startled to hear an amateur radio station in Ohio sending a message addressed to K. B. Warner, secretary of the American Radio Relay League at Hartford. Mr. Jenson, remembering that Mr. Warner was one of his regular customers, copied the message and delivered it on his regular round within the next hour.

* *

One of the Vagaries of Radio Waves

IT is the common complaint of the broadcasting listener that he is unable to hear a certain station because "it is too far away"; the amateur radio telegrapher, on the other hand, often makes the complaint that he cannot hear another amateur station "because it is too near." A striking example of this is furnished by a radio message that a San José (California) amateur wished to send by short waves to his friend at Carmel. The distance between the two points is slightly more than fifty miles, but due to the habit that short waves have of angling into the upper atmosphere before being reflected back to earth, the two stations were unable to hear each other at all. Finally, the San José station, 6HB, recollected that 6HM, at Carmel, kept a regular schedule with an amateur in Singapore, Asia, and as this point was easy for each to reach, he sent the message to the Singapore amateur—who immediately relayed it to the Carmel amateur! The answer came back over the same route the next night. The message and answer together covered a distance of 32,000 miles in order to bridge the fifty-mile gap.

TRUPHONIC *STANDARD* AMPLIFYING TUBES ARE DESIGNED ESPECIALLY FOR TRUPHONIC AUDIO AMPLIFICATION—AN H. P. DONLE DEVELOPMENT.

IN USING THIS MOST EFFICIENT FORM OF AMPLIFICATION—WHETHER BUILT INTO YOUR SET BY THE MAKER OR AS A SEPARATE UNIT—THE HIGHEST EFFICIENCY IS REACHED BY THE USE OF THESE TUBES.

LITERATURE ON THIS AND OTHER PRODUCTS SENT ON REQUEST

THE DONLE-BRISTOL CORPORATION
56 CAMBRIDGE STREET
MERIDEN—CONNECTICUT—U. S. A.

"Greatest Receiver Ever Developed"

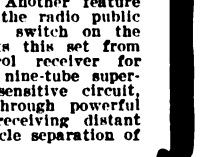
In the latest issue of the *Citizens Radio Call Book*, there is a descriptive article regarding the *New Camfield Super-Selective Nine* Receiver. This circuit is considered by experts as the greatest receiver ever developed. An outstanding achievement is the simultaneous increasing of both selectivity and sensitivity to a point heretofore considered impossible.

CAMFIELD'S
Super-Selective Nine

The *Super-Selective Nine* offers to set builders unusual opportunities, for here is a circuit that will meet every requirement for the very best in radio reception. Another feature that will appeal to the radio public is the turning of a switch on the panel, which converts this set from a 5-tube, two-control receiver for local stations, to a nine-tube super-selective and super-sensitive circuit, capable of tuning through powerful local stations and receiving distant ones on a ten Kilocycle separation of frequency.

Write today for book on this wonder circuit and have the facts before you. Use the handy coupon below. Send 25c. today—now.

25¢



Camfield Radio Mfg. Co.
357-364 E. Ohio Street,
Chicago, Ill.

mail Coupon now

Camfield Radio Mfg. Co.
357-364 E. Ohio St., Chicago, Ill.
Enclosed find 25 cents for booklet, "Camfield's Super-Selective 9."
Name.....
Address.....

SANGAMO
MICA CONDENSERS
IN
intermediate
SIZES

IMPROVE TONE RANGE and VOLUME

IT is accuracy, not luck, that makes one receiver more selective or sensitive than another that is almost its twin. Condenser accuracy is especially important and the cost of accurate condensers is small—the effect immense.

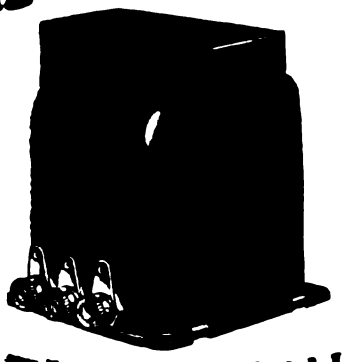
Capacities in microfarads and prices

0.00004	40c	0.001	50c.
0.00005		0.0012	
0.00006		0.0015	
0.00007		0.00175	
0.00008		0.002	
0.0001		0.0025	
0.00012		0.003	60c.
0.00015		0.0035	
0.000175		0.004	
0.0002		0.005	70c.
0.00025		0.006	85c.
0.0003		0.007	90c.
0.00035		0.0075	95c.
0.0004		0.008	$1.00
0.0005		0.01	1.15
0.0006		0.012	1.20
0.0007		0.015	1.25
0.0008			

With Resistor clips, 10c. extra.

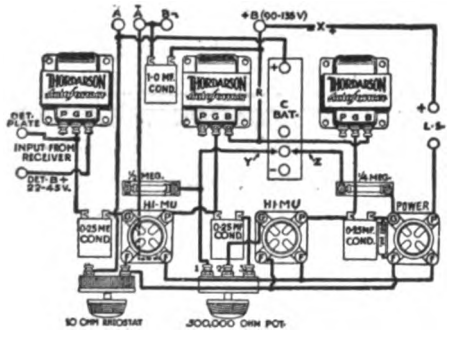
Sangamo Electrical Company
6332-I *Springfield, Illinois*
RADIO DIVISION, *50 Church Street, New York*

Ideal for Coupling the new Hi-Mu tubes



THORDARSON
Autoformer
Trade-Mark Registered

All Frequency Amplifier



The Thordarson Autoformer, used as a straight impedance, makes an ideal coupling medium for the new Hi-Mu tubes UX-240 and CX-340.

The excellent tonal reproduction of the Autoformer, combined with the high amplification of the Hi-Mu tubes plus a power tube on the output, will transform your receiver into a real musical instrument.

The Autoformer is available at all good dealers at a price of $5.00.

Mail this coupon today for more detailed information.

THORDARSON ELECTRIC MFG. CO.,
500 W. Huron St., Chicago.

Gentlemen:
Please send me more detailed information on the use of the Autoformer with Hi-Mu tubes.

Name.....

Address.....

3553-A

Trans-Oceanic Calls Heard

THE following stations were received and logged at the amateur station of Edward J. Sampson (NU-1DI), 15 East Ashland St., Brockton, Mass., using a Hertz type antenna 30 feet high and a Schnell short-wave receiver:

EF-8MAX—March 10, 1927; signal strength R7; 40 meters; some interference and static; fine rectified AC note; no fading;
EF-8UDI—March 6, 1927; signal strength R6; 40 meters; very bad interference and static; fine rectified AC note;
EF-8GI—February 27, 1927; signal strength R7; 40 meters; good AC note; no fading;
EI-1CR—February 23, 1927; signal strength R7; bad static and interference; good rectified AC note; no fading;
EF-8PX—March 4, 1927; signal strength R6; 40 meters; some static and interference; fine rectified AC note; no fading;
EB-4WW—March 4, 1927; signal strength R8; 40 meters; some static and interference; fine rectified AC note; no fading.

THE following stations were received and logged at the amateur station of S. Williamson (G-2ACI) at 22, Hurst Grove, Bedford, England, using a Reinartz receiver with one stage of low-frequency amplification:

NU-3JW—Oct. 2, 1926; signal strength R4; calling CQ on 38.8 meters; AC note; no fading;
U-5AC—Oct. 2, 1926; signal strength R4; AC note on 42 meters; interference R5; no fading;
NU-8BRC—Oct. 2, 1926; signal strength R6; calling 9CB on 39 meters; DC note; no fading; very clear signals;
NU-8AZS—Oct. 3, 1926; signal strength R6; calling 8ADU on 34 meters; AC note; no fading;
U-8KP—Oct. 12, 1926; signal strength R5; calling 1AMD on 35.8 meters; AC note; no fading;
NU-3AY—Oct. 31, 1926; signal strength R3-4; calling G-6YW on 42 meters; AC note; fading at 2-second intervals;
NU-5AB—Oct. 31, 1926; signal strength R2; calling CQ on 41.5 meters; DC note; no fading;
NU-9BQE—Oct. 31, 1926; signal strength R3; calling CQ on 38.4 meters; DC note; no fading;
NU-8BRD—Nov. 20, 1926; signal strength R1-5; AC note on 42 meters; fading at 4-second intervals;
NU-4AP—Dec. 27, 1926; signal strength R3; AC note on 35.5 meters; no fading;
NU-4IO—Feb. 6, 1927; signal strength R5; calling SB-1AC on 40.7 meters; AC note; no fading;
NU-8ALY—Feb. 6, 1927; signal strength R3; calling 6FC on 36.5 meters; interference R4;
NU-3QW—Feb. 6, 1927; signal strength R3-5; calling 1ABX on 41.4 meters; DC note; fading at 3-second intervals;
NU-8AMU—Feb. 6, 1927; signal strength R5; calling CQ on 38 meters; atmospherics R4; AC note; no fading;
NU-2ALW—Feb. 20, 1927; signal strength R2-4; calling CQ on 19.9 meters; AC note; fading at 5-second intervals;
NU-2GP—Feb. 20, 1927; signal strength R3-6; calling CQ on 19.7 meters; AC note; fading at 7-second intervals;
U-1CPB—Feb. 20, 1927; signal strength R6; AC note on 20.5 meters; no fading;
NU-1ASR—Feb. 20, 1927; signal strength R1-3; calling 9BFF on 20.5 meters; AC note; fading at 10-second intervals;
NU-1IO—Feb. 20, 1927; signal strength R3-5; calling CQ on 19 meters; AC note; fading at 6-second intervals;
NU-8AHC—Feb. 20, 1927; signal strength R5-7; calling CQ on 19.8 meters; DC note; fading at 3-second intervals;
NU-8AM—Feb. 27, 1927; signal strength R4; AC note on 41.7 meters; atmospherics R4; no fading.

* *

Egypt's Lone, Mysterious Broadcaster

THE land of the Pharaohs has no actual authority or regulations for the broadcasting of news or entertainment. Nevertheless it has offered an occasional broadcast program from an unlicensed but tolerated station at Cairo. It is said to be operated by an amateur, unnamed and unknown. This station (which is the only one in all Egypt) is dubbed SRE by the many fans who tune in regularly for news, sporting events, such as horse races, and musical programs. It broadcasts on 255 meters with sufficient power to reach a large number of listeners in and around Cairo; on some occasions a Government band has been heard, and once a governmental official is said to have spoken, although the Government is not supposed to recognize it because of its lack of official status. It is tolerated chiefly because it has great popular appeal and no one wants to stop its operation. With the backing of the people and the press, this sole and more-or-less outlaw broadcaster, who has been in operation over a year, is now considered a local institution.

* *

The New "Radio Division"

To assist the Secretary of Commerce in carrying out the new responsibilities imposed upon him by the newly-enacted radio laws, Secretary Howe has just created a Radio Division in the following official terms:

"The Radio Division established in the Bureau of Navigation to assist the Secretary in the performance of the duties imposed by the Acts of June 24, 1910, July 23, 1912, and February 23, 1927, relating to radio communication, in carrying out the International Radio Telegraphic Convention, and in the examination and settlement of international radio accounts, will hereafter be administered independently of the Bureau of Navigation, under the Secretary's immediate supervision; and such duties as have heretofore been performed by the Comissioner of Navigation with relation to the administration of the radio communication laws will be performed by the chief of the division. For the time being, the records of personnel and accounts, and other similar matters of administrative detail, will continue to be handled by the proper divisions of the Bureau of Navigation.

"Mr. William D. Terrell, chief radio supervisor, Bureau of Navigation, is designated Chief of the Radio Division."

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A NEW FREE SERVICE To Set Builders

POPULAR RADIO

Laboratory tested sets are easier to build if you use our FREE PICTURE WIRING DIAGRAMS with our

SIMPLIFIED FULL SIZE BLUEPRINTS

A radio set constructed from one of our kits is not only easier for the experimenter to build, but its appearance both inside and out, makes it more valuable to you.

Every Stamford Shop Kit includes a set of full size simplified Blueprints. An instrument layout shows every part in exact size and position. A picture-wiring diagram shows where and how to connect each wire. By following the wiring plan of the designer your set cannot fail to perform more efficiently.

Our Kits contain everything needed to complete the set, down to the last piece of buss bar and screw. Every panel is machine-drilled and artistically decorated.

Check opposite the sets you are interested in for complete data and prices of kits and parts.

Write for Prices on
Hammarlund-Roberts Hi-Q
as described in this issue

WE BUILD SETS TO ORDER
Write for Prices

Just Tear this Advt. out

—

Let Us Quote You on—

Gentlemen: Without obligation, send me full information and prices on sets which I have marked X.

☐ Hammarlund-Roberts Hi-Q
☐ Cockaday's LC-27
☐ Improved Browning-Drake
☐ S-C, Single control. All Wave
☐ PORTABLE TEST BOARD
☐ QUALITY AMPLIFIER
☐ SHORT WAVE EQUIPMENT

I enclose $1.00 for Simplified Blueprints

RADIO SHOP OF STAMFORD
20 Worth St. Stamford. Conn.

Statement of the ownership, management, circulation, etc., required by the act of Congress of August 24, 1912, of POPULAR RADIO, published monthly at New York, N. Y., for April 1, 1927, State of New York, County of New York.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Douglas H. Cooke, who, having been duly sworn according to law, deposes and says that he is the Publisher of the POPULAR RADIO and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Douglas H. Cooke, 627 West 43d Street, New York City, N. Y.; Editor, Kendall Banning, 627 West 43d Street, New York City, N. Y.; Managing Editor, Kendall Banning, 627 West 43d Street, New York City, N. Y.; Business Manager, E. A. Harm, 627 West 43d Street, New York City, N. Y. 2. That the owner is: POPULAR RADIO, Inc., whose stockholders are: Douglas H. Cooke, 627 W. 43d Street, New York City; Kendall Banning, 627 West 43d Street, New York City; Laurence M. Cockaday, 627 West 43d Street, New York City; Theodora W. Cooke, 59 Beechmont Drive, New Rochelle, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: NONE. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. Douglas H. Cooke, Publisher. Sworn to and subscribed before me this 1st day of April, 1927. Sadie M. Nilan, Notary Public, Queens County. (My commission expires March 30, 1928.)

SM

Build the S-C II

Take home a set of parts any evening—your dealer has them—and build yourself an up-to-the-minute radio set. After you've had a couple of hours' fun in the kitchen putting the S-C II together, hook 'er to the loud speaker and just listen to the stations pound in.

You'll lean back in your chair with a sense of a good job well done—and money saved—and as you listen to your favorite program, you won't be able to help exclaiming, "Oh, boy! *that's* music." And the family will agree with you, for once.

Then as you look with pride at the S-C II *you've* built all yourself, you'll appreciate its big value—complete individual shielding, sturdy steel chassis and panel, its two simple tuning dials, tone quality that pleases even the neighbors—real value and satisfaction just sticking out all over, and it cost you only $64.35, plus lots of fun.

Ask your dealer for a booklet on S-M parts, or write direct.

SILVER-MARSHALL, INC.
844 West Jackson Blvd. Chicago, U.S.A.

XL Products

Pep up Your Set!

Quick, easy tuning—more volume, clearness, stability, with an X-L VARIO DENSER in your circuit.

Specified and endorsed by foremost Radio designers in all latest and best hook-ups.

Model "N" A slight turn obtains correct tube oscillation on all tuned radio frequency circuits. Neutrodyne, Roberts two tube, Browning-Drake, McMurdo Silver's Knockout, etc., capacity range 1.8 to 20-micro-microfarads. **Price $1.00.**

Model "G" with grid clips obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in heterodyne and positive grid bias in all sets. Capacity range:

Model G- 1—.00002 to .0001 MFD
Model G- 5— .0001 to .0005 MFD
Model G-10— .0003 to .001 MFD
Price $1.50

X-L PUSH POST. Push it down with your thumb—insert wire, remove pressure and wire is firmly held—vibrations will not loosen — releases instantly. **Price 15c.**

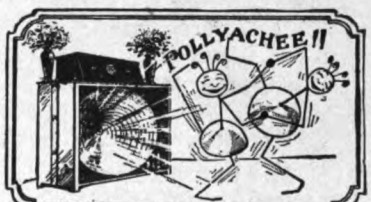
PUSH POST PANEL permanently marked in white on black insulating panel. In box including soldering lugs, raising bushings and screws for mounting, etc. **Price $1.50**

Build the new LOFTIN-WHITE constant coupled radio frequency circuit. FREE wiring diagrams showing use of this and other popular circuits sent on request.

X-L Radio Laboratories
2422 Lincoln Ave., Chicago, Ill.

"World's Finest 3-Ft. Cone or Roll-Type" Loud-Speaker "ENSCO" KIT ONLY $10

Assemble in Less Than an Hour



Complete parts furnished in kit form. We guarantee this speaker the equal of any manufactured cone speaker considering price.

With this THREE FOOT CONE SPEAKER you hear ***all*** the tones. It brings out the true depth and beauty of orchestral and instrumental music. Can be operated softly for living room music or full volume for dancing, and without trace of distortion.

Kit includes famous "ENSCO" cone unit, the only direct drive, distortionless unit for large cones; Alhambra Fonotex for big cone, with brass apex, two Blue Prints showing cabinet, stand, or roll-type construction. All necessary instructions for assembling.

Buy this wonderful speaker under our absolute guarantee. ***Your money back*** if you are not convinced that it is the finest reproducing medium. It works on any set, with ordinary Tubes or with Power Output.

ORDER COUPON—SEND NO MONEY

Write your name plainly as indicated below, then mail and complete kit will be forwarded to you. Just pay postman $10.00 upon delivery.

Name.....

Address.....

ENGINEERS' SERVICE CO.
25 CHURCH ST. Desk Z NEW YORK CITY

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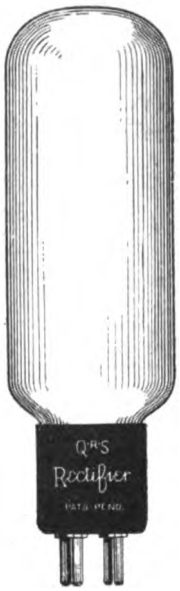
Q·R·S·

RADIO TUBES *ARE* BETTER!

201A Type, $1.75 ***Super Detector, $4.00*** ***Power Tube, $4.50***

ANNOUNCING—



400 Milliamperes
Price, $7.00

We also make the same tube in 60 or 85 milliamperes as used in the Varion Power Pack described in this issue.

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The First 400 Milliampere

Gas Rectifier Tube

(Patents Pending)

A Revolutionary Step in Radio History

After two years of intensive laboratory experiments we have developed a 400 milliampere gas rectifier tube, that solves the A, B and C power supply problem. Eliminates all batteries and all AC hum in any set up to ten tubes.

Delivers 400 milliamperes at 300 volts.

Diagram and list of parts for A, B, C Eliminator sent free on request

THE Q·R·S· MUSIC COMPANY

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Factories at: **Chicago—New York—San Francisco—Toronto, Canada—Sydney, Australia—Utrecht, Holland**

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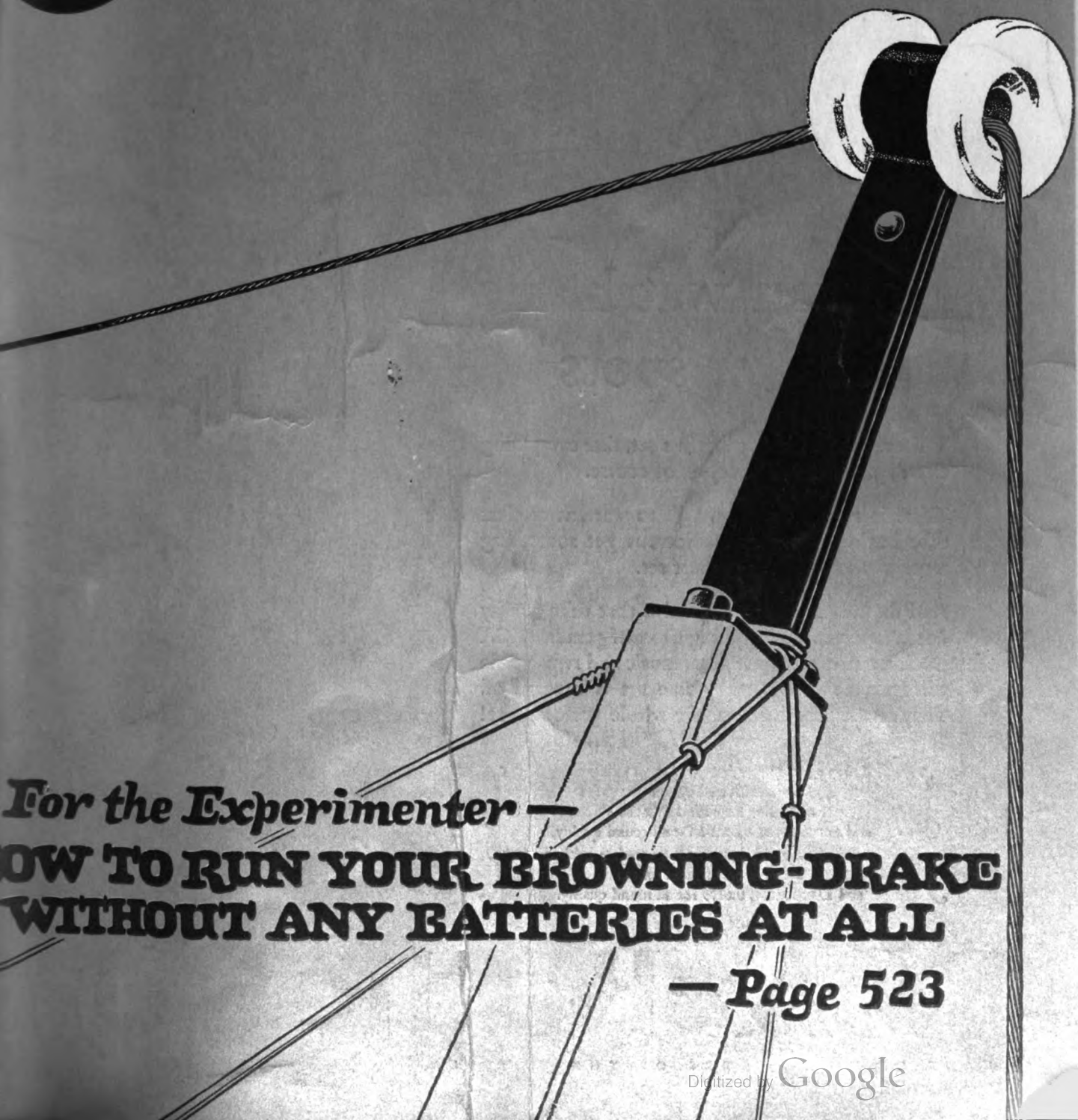
Popular Radio

25¢

JUNE · 1927



For the Experimenter —

OW TO RUN YOUR BROWNING-DRAKE WITHOUT ANY BATTERIES AT ALL

— Page 523

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Do you watch the "danger spots"

What are the critical points in a set, that everything else depends on? The tubes, of course.

There is no set cheap enough to warrant careless tube buying. Genuine Radiotrons get something more out of even the poorest set.

And there is no set so expensive that tube quality doesn't matter. For, nothing short of genuine RCA Radiotrons can get the great music and remarkable performance that a really fine set is capable of. They're the very heart of the whole performance!

Bring your storage battery set up-to-date with
a *power* RADIOTRON UX-171 or UX-112
a *detector* RADIOTRON UX-200-A
and RADIOTRONS UX-201-A for all-round quality
Bring your dry battery set up-to-date with
a *power* RADIOTRON UX-120
and RADIOTRONS UX-199 for all-round quality.

A WATCHMAN ON THE INSIDE

THE SILVER COLOR inside a genuine Radiotron UX-199 and UX-201-A is a chemically active substance always on the lookout.

How it gets there is an important story. It is caused by the sudden evaporation of a bit of chemical inside the tube, to make the most nearly perfect commercial vacuum still more complete! But, after three methods of exhaust are applied to your Radiotron, there may still float about in it a few atoms of air or gas. They may be invisible to the finest microscope, but they get in the way of perfect reception. The silver color in the tubes, however, is an active film that attracts and holds these air atoms—keeps them away from the vital parts of the tube—makes it work better—last longer.

When you are buying a tube of the silvery type, and want to make sure of the efficiency of that inside watchman, just be sure to get a genuine RCA Radiotron. The mark is on the bottom.

RCA

RADIO CORPORATION OF AMERICA

New York Chicago
San Francisco

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA

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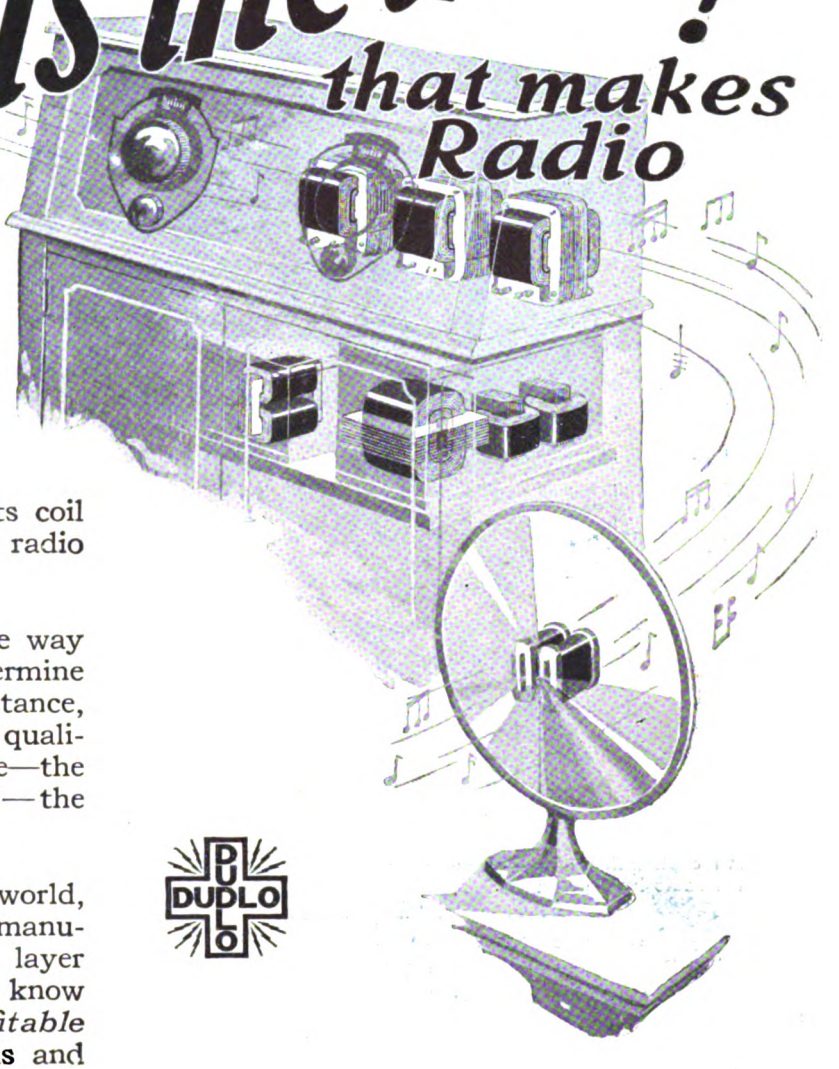
The Coil's the thing! that makes Radio



From Microphone to Loud Speaker

No radio unit is any better than its coil for the coil is the vital part of all radio apparatus.

Coils in the microphone and all the way down the line to the loud speaker determine the volume, the selectivity, the distance, and, most important of all, the tone qualities. Coils cannot be too well made—the wire in them cannot be too good—the insulation cannot be too perfect.

The best radio apparatus in the world, made by the most successful radio manufacturers, is equipped with Dudlo layer wound coils. These manufacturers know from experience that it is *unprofitable* to attempt to wind their own coils and *unwise* to experiment on doubtful sources of supply for parts so highly specialized and so important as their coils.

By standardizing on Dudlo wire and coils, you can avoid all worry as far as these units are concerned.

Dudlo coils are wound to manufacturers' specifications. The Dudlo Engineering Laboratories are at the service of any radio manufacturer to assist in designing the proper coil for certain purposes—samples submitted without obligation.

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Popular Radio

EDITED *by* KENDALL BANNING

FOUNDED 1911

VOLUME XI | June, 1927 | NUMBER 6

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Raytheon BA
350 m. a.
(Half size)

Raytheon's leadership in the rectifier field is demonstrated again by the announcement of these sensational new rectifiers, worthy to take their places alongside Raytheon Types B and BH.

Raytheon A
2½ amps.
(Actual size)

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With One Rectifier

By this amazing rectifier, Raytheon BA-350 m. a., the final great step in the development of radio power is accomplished. Compact, built-in A-B-C power, without accessories, becomes a fact.

Soon a specially selected group of leading radio manufacturers will announce their newest receivers, using Raytheon BA-350 m. a. Standard 201-A tubes are used, and all batteries, chargers, accessories, and outside power equipment are eliminated.

Raytheon BA-350 m. a., the crowning accomplishment of the Raytheon Research Laboratories, has at last given the radio world a practical, proven solution to the problem of simple light socket receiver operation.

A Revolutionary Scientific Achievement
In High Current, Low Voltage Rectification

Raytheon A-2½ amps. is revolutionary in principle, in construction, in performance. It is an unbreakable metal cartridge, compact and simple, without liquids or filaments.

Above all, it is The Efficient Rectifier. Its operating cost over the period of a year, compared with that of other types of rectifiers designed for similar uses, will show a cash saving of many dollars.

Raytheon A-2½ amps. was invented by Monsieur André of La Radiotechnique in Paris, and developed by the Raytheon Research Laboratories with his cooperation.

Battery chargers and A power units using this remarkable rectifier will bear the same seal of approval that distinguishes all Raytheon-equipped power devices.

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Cambridge, Massachusetts

DESIGNED FOR USE WITH Raytheon LONG LIFE RECTIFYING TUBE

Only manufacturers whose units have been tested and approved by Raytheon may use this seal on their products.

New Prices

Type B . .	$4.50
Type BH . .	6.00
Type BA . .	7.50
Type A . .	4.50

Raytheon

The Heart of Reliable Radio Power

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A Page With The Editor

THE next issue of POPULAR RADIO (for July) will contain announcements of very special interest and value to radio experimenters and broadcast listeners alike—announcements of new radio receivers and of new radio accessories that will be available during the coming season.

* *

THE July issue will be, in effect, a special "What's New in Radio" number, prepared for the information and guidance of the readers of POPULAR RADIO.

* *

FOR many weeks the Technical Staff of POPULAR RADIO has been in touch with inventors and manufacturers, collecting information about their new and improved apparatus, and testing the advance models in the POPULAR RADIO LABORATORY.

* *

THE data obtained in this comprehensive survey has not only revealed many of the surprises that are in store for the fan, but augurs a radio season that will exceed all that have gone before.

* *

No previous year has shown such a varied advance in the radio art, nor offered as much of real value to the experimenter or listener, in the form of receiving sets, of loudspeakers, and of parts, as will the season that formally begins the middle of June with the opening of the Radio Manufacturers' Association's exhibit in Chicago on June 13th.

* *

AND the apparatus of outstanding merit will be pictured and described in the forthcoming July issue of POPULAR RADIO—which no real fan can afford to miss.

* *

FIVE years ago, when radio broadcasting burst upon an amazed and delighted public and everyone hastened to buy and assemble radio apparatus, the talking machine industry all but turned up its toes and died.

* *

FOR the public spent its money on its new toy—and for the moment laid its old toy aside.

* *

BUT the talking machine industry slowly began to awaken to the fact that the radio art, and the electrical engineers and experimenters who were developing it, were placing at the disposal of the talking machine industry new apparatus and new scientific principles of sound reproduction that could be put to its own practical use.

With this discovery the resuscitation of the talking machine industry began.

* *

By the aid of the microphone, electrically recorded talking-machine discs made their appearance—an enormous improvement over the old mechanically recorded discs.

* *

THE new line of 1927 models of talking machines, based upon new principles of sound reproduction developed by the radio experts, has classified the old-fashioned talking machine with the one-horse shay.

* *

THE use of low-frequency amplification systems—another contribution by the radio experts—has made possible a quality of tone and volume of sound that has given the talking machine an importance that was never before attainable by the old method.

* *

AND now the hour is approaching when the talking machine and radio will be literally as well as figuratively united—through the medium of a newly developed little device known as an "electrical pick-up" that may be attached to the ordinary talking machine (in place of the usual mechanical "recorder") and which is connected by a wire directly to the radio receiver itself, or better still, to an independent amplifier.

* *

BY means of this remarkable little instrument (that will eventually be on the market at a price within the reach of all) a quality and volume of reproduction is possible that is exactly the same as that of the $1,000 talking-machine equipped with low-frequency amplifiers—an instrument that is capable of filling a large auditorium with sound!

* *

This "electrical pick-up" device (and there are several variations of it that are now awaiting attention in the Patent Office) opens up a new era in the musical arts. And it will be described in the coming (July) issue of POPULAR RADIO.

* *

THE advent of this instrument will place at the disposal of radio and talking-machine fans generally a quality of music reproduction that has heretofore been reserved for the exclusive few. And it opens up new markets to the manufacturers of radio apparatus and talking-machine records as well.

* *

ONE of the interesting and significant results of a recent survey made by The National Broadcasting Company revealed that whereas three years ago 75 per cent of the radio fans expressed a desire for jazz, only 5 per cent express that desire now.

* *

THAT the demand for jazz is decreasing is an opinion that is apparently based upon substantial evidence—by questionnaires from listeners as well as data furnished by music publishers and others. Many, if not most people, believe that this gradual change augurs well for the radio fan, the radio industry, and for the musical art.

* *

OUT in Grand Rapids, however, there is an incorrigible fan who just plumb won't stand for this conclusion, and who has discontinued his subscription to POPULAR RADIO because it has published what he designates as "editorial criticism of broadcasting jazz music."

* *

STILL, once we knew a man who complained to the House Committee of his club that "the hot water was too hot!"

* *

MR. UTHAI VINCENT WILCOX, who contributes this article, "The First Scientific Evidence of the Existence of the Radio Ceiling," is a Washington, D. C., newspaper correspondent who contributes articles occasionally to the leading magazines. He is one of a group of four correspondents who are keeping in touch with the scientists and experimenters in the National Capital for the benefit of the readers of POPULAR RADIO.

* *

"'SQUEALS'—What They Are and How to Stop Them," which appears on pages 530-532 of this issue, was contributed by Mr. Edward G. Fracker, one of the radio experts of the Bell Telephone Laboratories. Mr. Fracker is one of the old-timers in radio; he entered the Government service back in the old "spark" days, and later continued his research work with the Westinghouse Company in the development of radio receiving apparatus.

* *

JOSEPH CALCATERRA, who contributes the article on the RGS receiver, has been engaged in radio and its allied activities since his early youth. His journalistic work began as Information Editor—and later as Radio Editor—of *Popular Science Monthly*. For three years he contributed a series of daily radio articles to the United Feature Syndicate. He is widely known to radio fans and experimenters.

Kendall Banning

Editor, POPULAR RADIO

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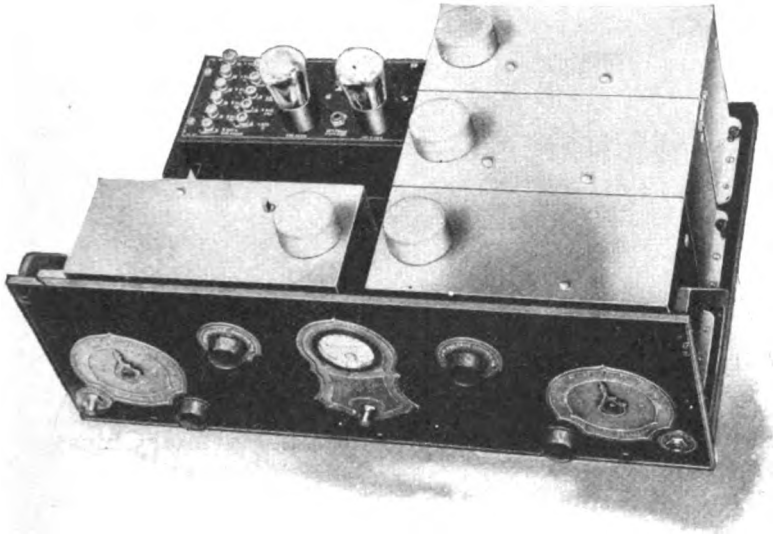
For better reception—

Copper Shielding



This Stromberg-Carlson six-tube Neutrodyne set, No. 601, is completely shielded with sheet Copper

Write for our new book on Copper Shielding. There is no cost or obligation.

Copper shielding gives closer selectivity and finer tone quality.

Sheet Copper combines higher conductivity with easy working qualities.

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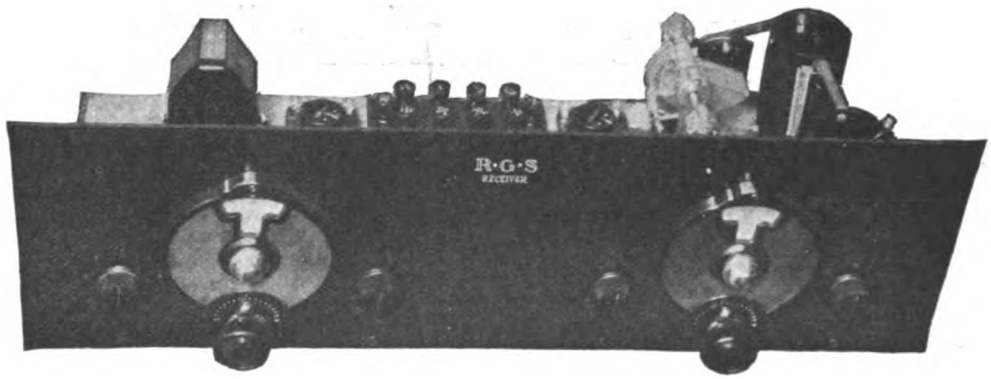
Insist on hearing RGS this receiver

The R. G. S. RECEIVER



1. Four tubes, CX-371 in last stage.
2. Two dials—nearest possible approach to tuning efficiency.
3. Equal selectivity on the upper half as well as on the lower half of the dial without being at all critical at any point.
4. Selective enough to pierce barrage of "local" stations in most congested broadcast areas such as New York City, Chicago, San Francisco.
5. Sensitive enough to "bring-in" St. Louis, Denver, Miami Beach, Havana, Chicago and even San Francisco through New York City "locals".
6. Straight line radio frequency amplification.
7. Straight line volume control.
8. Tonal quality comparable to, if not superior to, any $300.00 set.
9. Enough volume to blast a Western Electric Cone.
10. With Cunningham Power Tube in the last stage, draws but 19½ milliamperes.
11. Antennae control.
12. Scientifically selected and closely co-ordinated apparatus. (National Co., Samson Electric Co., DeJur Products, A. H. Lynch, Inc., Sangamo Electric Co., Central Radio Laboratories, Inc., Grimes Radio Engineering Co., Inc., Acme Wire Co., Westinghouse Mi-Carta, H. H. Eby Co., etc.)
13. R. G. S. Receiver adaptable to any good standard cabinet. (List of names on request.)
14. Following accessories for best results: Cunningham Radio Tubes, Eveready Batteries, Western Electric Cone.
15. Sold two ways: (1) Complete kit of parts, $69.70; (2) Completely assembled by latest laboratory methods, (without cabinet or accessories), $79.70.

$79.70

Assembled by Latest Laboratory Methods
Without Accessories or Cabinet

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Complete Kit of Parts
Without Accessories or Cabinet

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BUILT FOR MODERN X BROADCAST CONDITIONS

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Garo

The Progressive Policy of POPULAR RADIO

"I have always had a great regard for POPULAR RADIO. *Its moderate yet progressive policy, and its carefully maintained quality, both commend it to me. It is doing a good job!"*

Tobe C. Deutschmann

PRESIDENT, TOBE DEUTSCHMANN COMPANY.

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Bell Telephone Laboratories

Winged Faces Joined to Winged Words

On April 7, 1927, the American Telephone and Telegraph Company demonstrated television, both by telephone and by radio. As Mr. Walter S. Gifford, President of the Company, talked by telephone with Secretary Herbert Hoover, in Washington, he saw within the hooded frame in front of him a moving image of Mr. Hoover, painted in the glow of a neon lamp. The transmitted electric signals represented small units of Mr. Hoover's countenance, illuminated successively by a rapidly-moving spot of light at Washington. Energized by these signals, the neon lamp at New York reproduced each spot of light and shade so rapidly that the result blended into a smoothly-moving picture. At Mr. Gifford's left is Mr. F. B. Jewett, Vice President of the American Telephone and Telegraph Company. At the left is Dr. Herbert E. Ives, head of the group of engineers who are responsible for the development.

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Popular Radio

VOLUME XI June, 1927 NUMBER 6

WHAT SHALL WE DO WITH

TELEVISION?

Some people think that science is moving too fast for mankind to keep up. Television is its latest marvel—foreshadowed by the experiments of Jenkins, Baird and others already described in POPULAR RADIO, now accomplished in still a different way. Will television be a useful aid to mankind or an annoyance or merely a scientific toy?

By THOMAS ELWAY

THE age of television is upon us. Even before the remarkable demonstration presented by Dr. Herbert E. Ives and his associates of the Bell Telephone Laboratories on April 7, 1927, the experiments of Jenkins, Baird, Alexanderson and others had already made it probable that science would soon offer methods for "seeing" by radio or over the wires.

The Ives process puts the seal of certainty on this probability.

It is true that there are some present limitations. For example, all processes of television so far proposed involve the necessity of breaking up the image to be transmitted into a large number of smaller units, for each of which a separate signal must then be sent over the television link. To obtain the requisite speed for these small image units, Dr. Ives uses a moving spot of brilliant light, which spot passes rapidly over the scene to be transmitted. Necessary as a concession to speed, this device carries the limitation that the object to be viewed must be moderately simple and must be fairly close to the transmitter.

In Dr. Ives' tests the face of Mr. Hoover and other faces were seen distinctly over the wire. A scene from a play or the view out of a window could not have been transmitted. The moving light spot would not have reached, for example, the slopes of a distant mountain, to carry their image into the wire.

Mr. Baird's method of obtaining his unit images by a series of separate viewing tubes* avoids this difficulty but falls into others due to the small amount of light provided for each unit and the consequent slower speed.

No present television process can be considered perfect, but that is no reason for pessimism. Improvements will come; perhaps totally new processes will be discovered. The age old dream of the writers of fiction to "see at a distance" or through walls or around obstacles will be granted to us very soon at the hands of the master magicians of modern science.

The question for those of us who are not members of this magical fraternity which serves us nowadays so usefully is this: What are we to do with television now that we are to have it?

When the telephone was first invented many men of ability, including scientists as well as the individuals of more "practical" outlook, inspected it with interest but regarded it as nothing but a scientific toy. That it could have practical utility was, to their minds, a piece of the wildest optimism on the part of Professor Bell. Everyone knows now how utterly wrong these pessimists were. It is doubtful whether any scientific invention of the past century has revolutionized business and living as completely as has the little electromagnetic vibrator with which Professor Bell and Mr. Watson conducted their historic conversation a half century ago.

Is television destined to be equally revolutionary? Or is it to be merely another scientific toy which university laboratories can play with and which the occasional wealthy amateur of science can use to entertain his after-dinner guests?

Admitting that to give a final answer to these questions would be the business of a seventh son and not of a mere observer of scientific progress, it may be interesting, none the less, for the mere observer to try to foresee some of the things which a successful process of television may permit us to do; some of the revolutions, great or small, with which we are apt to be confronted now that the inventors have presented the

* See Mr. Baird's own description in POPULAR RADIO for November, 1926, pages 649-650.

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world with a successful distance-seeing device.

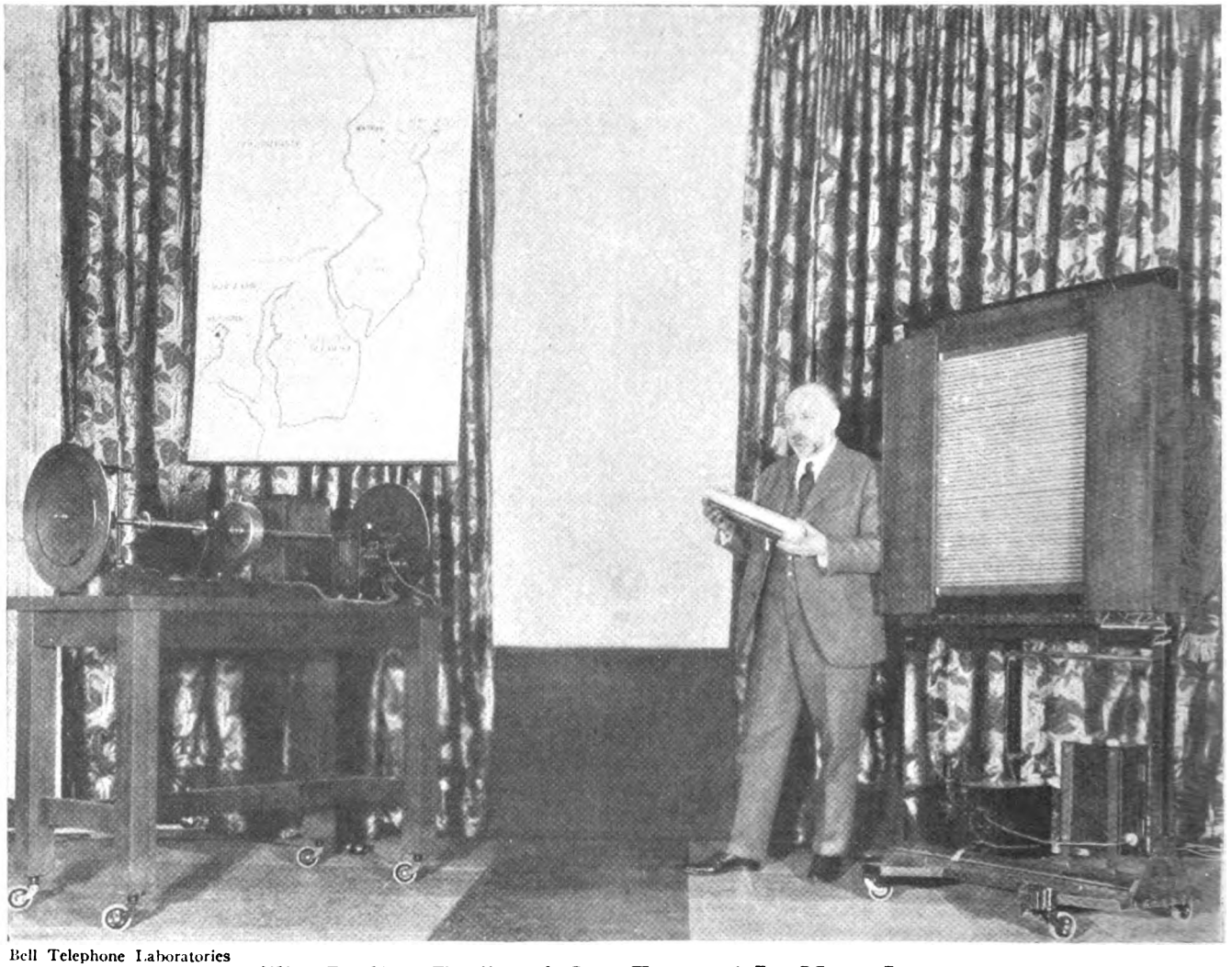
It is possible to think of uses of television which would not be universally popular. In families where argument exists about Papa's taste in neckties a television apparatus at the haberdasher's, over which Mama could inspect Papa's prospective purchase before it was an accomplished fact, might be welcomed by one side of the family less enthusiastically than by the other side. It is to be suspected, also, that the installation in club rooms of television apparatus connectable to the members' firesides will be forbidden under suitable penalties in many sets of by-laws and house rules. A complaint often made, nowadays, by critics of modern civilization is that privacy has vanished. The famous Tyrant of Syracuse who installed a listening tube within his prison to hear what his victims said of him has been excelled by modern dictaphones and telephones. Television would give us the possibility of secret eyes as well as secret ears. Detectives would like this; criminals would not. As for the great mass of us who are not ordinarily of either persuasion, opinions would vary, doubtless, with the circumstances.

The possibility of television where it is not wanted need not concern us, however, as much as its possibility where it is wanted. We must remember, too, that there are two essentially different varieties of television, just as there are two varieties of telephonic communication.

One of these varieties is analogous to radio broadcasting. At some central station there will be prepared and broadcast the signals corresponding to visible things. Any persons desiring to see them will merely install the proper varieties of receiving apparatus and sit down and look. It is this procedure which has been begun in London by the well-known television experimenter, Mr. J. L. Baird.

The other variety of television is that demonstrated by Dr. Ives and the American Bell telephone system. It may be called the "link" system and is analogous to the present telephone system.

If you wish to talk to a friend halfway across the continent, the telephone company establishes for you a line or lines of wire connected, through many switchboards and exchanges, from your telephone to the instrument of your distant correspondent. It now becomes possible, although not quite so convenient, to establish a visual linkage of this variety between any two stations equipped with the proper apparatus. It is obviously possible to arrange this same linkage through radio channels.



Bell Telephone Laboratories

The Radio "Eye" and One Form of Its Neon Lamps

Dr. Herbert E. Ives, its inventor, is holding one of the large photoelectric cells which he uses to pick up light reflected from the sitter's face by the moving light-spot of the television transmitter. The electric signal thus produced is transmitted, amplified and used to illuminate the proper spot on the neon tubes in the frame at Dr. Ives' left. The successive glowing spots along these neon tubes reproduce the picture, as if on a screen. At Dr. Ives' right is the laboratory apparatus used in developing the system. Holes in the two spinning disks keep the light-spot of the transmitter and the eye of the viewer focussed on corresponding spots of the sitter's face and of the image.

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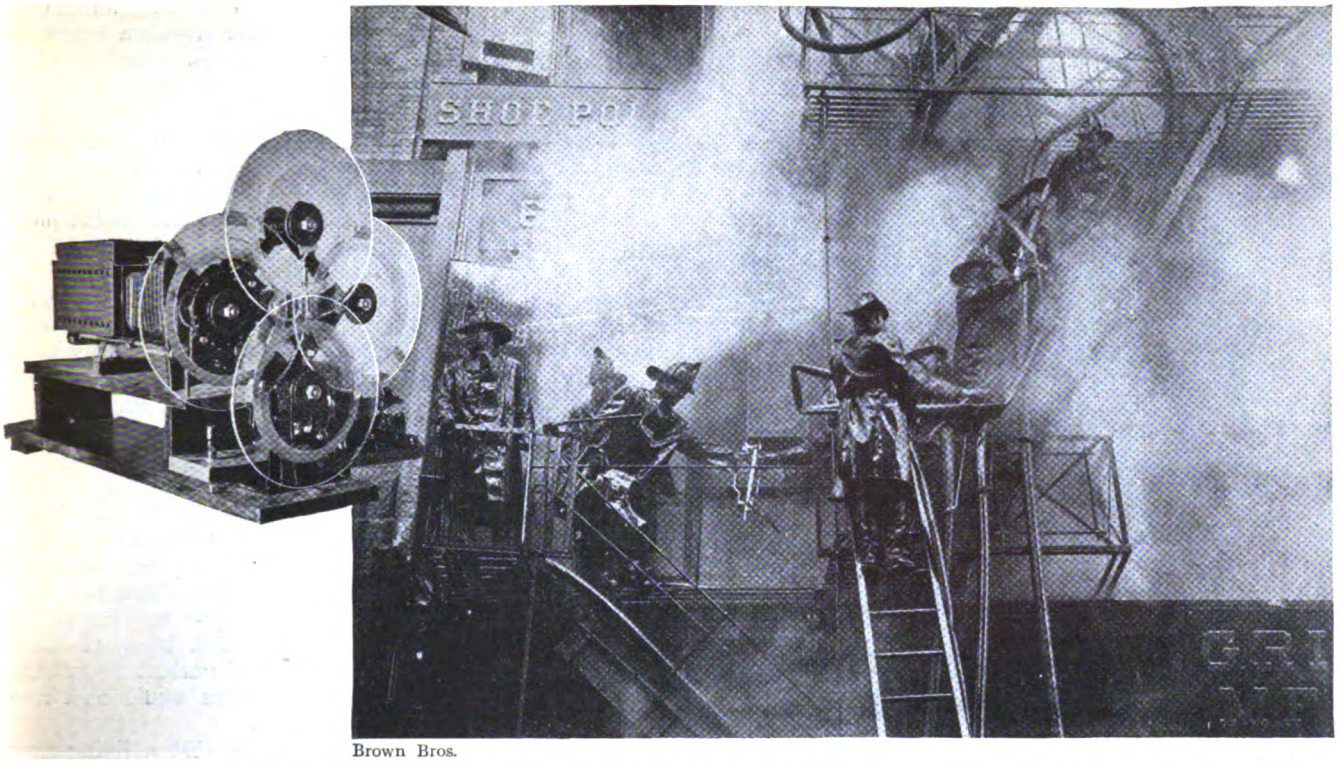

Brown Bros.

News Events May Be Projected on the Walls of Our Homes

Television transmitters, operated by experienced cameramen, may broadcast the world's doings direct from the scenes of action. Although no present process of television can yet "report" news events in pictures, it is not impossible that some day a machine may broadcast such spectacular events as this.

Venturing once more to usurp the prerogatives of the prophetical seventh son, let me suggest that this establishment of television linkage is apt to be not only the first real success of television but the chief permanent utility of that accomplishment.

The police departments of our various cities now enjoy a periodic institution called the "line-up." At convenient intervals criminals or suspected criminals who have fallen foul of the dragnet are lined up for inspection by members of the detective force. In some cities a truly dramatic note is added by the fact that the sleuths are masked; the intention being, of course, to prevent the criminals acquiring such familiarity with the features of their enemies as might make trouble for some unfortunate crime-detector later on.

"Not being a bird," said Sir Boyle Roche, "I cannot be in two places at once." Detectives suffer from a similar handicap. If a sleuth from one city wishes to inspect the catch of criminals in another city there is but one thing for him to do; he must get on the train and go. Meanwhile he will miss the catches from his own fishing grounds. To overcome this handicap our crime-detecting experts have devised such expedients as formalized descriptions, finger-prints, Rogues' Gallery photographs, and the like. No doubt these are useful, although it may be questioned whether any living criminal could possibly look as thuggish as do virtually all of the official photographs.

But how much better it would be if it were possible for the New York detective force to view each morning the line-ups in Chicago and Boston and Washington and Philadelphia, the distant cities enjoying, at the same time, an inspection of New York City's catch? Dr. Ives' machines now make this possible. If someone compelled me to select one particular use of television which was apt to be first in practical importance, I think that this is the one I would choose.

Next in importance will be, perhaps, the ability of experts to inspect objects or persons at a distance. It is already becoming customary for physicians to be consulted by telephone on behalf of distant patients. Some months ago the experts of the Bell Telephone Laboratories sent the heart-beat of a patient in Atlantic City over the wire to Chicago and got back again in a few minutes the Chicago expert's diagnosis of what was troubling the defective pump. As I write this article the newspapers carry an account of a patient in New Orleans consulting his physician in Paris by means of the transatlantic radio phone.

Now that it is possible to combine with this long-distance ear a similar extension for the eyes of the diagnostician, the handicap of distance on the medical specialist will virtually vanish. If some rich man in San Francisco feels that he will die without the aid of some specialist in New York it will no longer be necessary to hire a special train and to clear the track for the physician or for the patient. Some one of the admirable hospitals of the California city will be linked by television and by telephone to a similar examining room on the Atlantic. With the patient in one room, surrounded by physicians and nurses to do what the consultant may ask, and with the consultant listening and watching from three thousand miles away, such aid as the expert might be able to render will be supplied enormously more cheaply and (what is still more vital) enormously more quickly than could be done now even by every use of rapid railways and of still more rapid aircraft.

Again with the caution which should animate every amateur prophet, I am inclined to believe that this use of television in the art of healing will join its use in criminology as among the first and most important services of the inventions which are now assured.

Commercially, the use of television is apt to lag a bit behind its employment in matters of medicine or crime—matters which concern things so much more

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important than money. But even in commerce there are possible utilizations which seem promising and which may be developed rapidly. Many buyers from other portions of the United States make journeys each year to New York City. Others travel to still more distant centers, as the fashion experts congregate each year in Paris. The possibility of these trips and of the amusements which they are considered to require constitute, I understand, the most sacredly-guarded perquisites of being a buyer. If television interferes, this will be one of the places where television engineers will get themselves disliked.

I fear, however, that this is inevitable. It is obviously far cheaper, far quicker and much more convenient to inspect a new line of crockery or furniture by a combination of telephone and television than it is to make a trip for that purpose. Admittedly, the inspection will not be quite so perfect; there will be less opportunity for negotiation and there may be other disadvantages. Not all commercial purchases will be made by television, even if the art becomes as cheap and convenient as the telephone. But undoubtedly there exists here a commercial possibility which the experts in television will not fail to cultivate. And if we can but arrange to broadcast by television some of the cabaret shows which buyers are said to find so necessary as stimulants to their imagination, perhaps all of us can stay home more and do our own buying with equanimity.

Far more important than any of these commercial opportunities for television are some which are less likely to be undertaken in the beginning for the reason that they are important only to the scientists, who are always poor; these involve the possibility of sending the receiving eye of a television machine into places where the living human eye finds it inconvenient to venture.

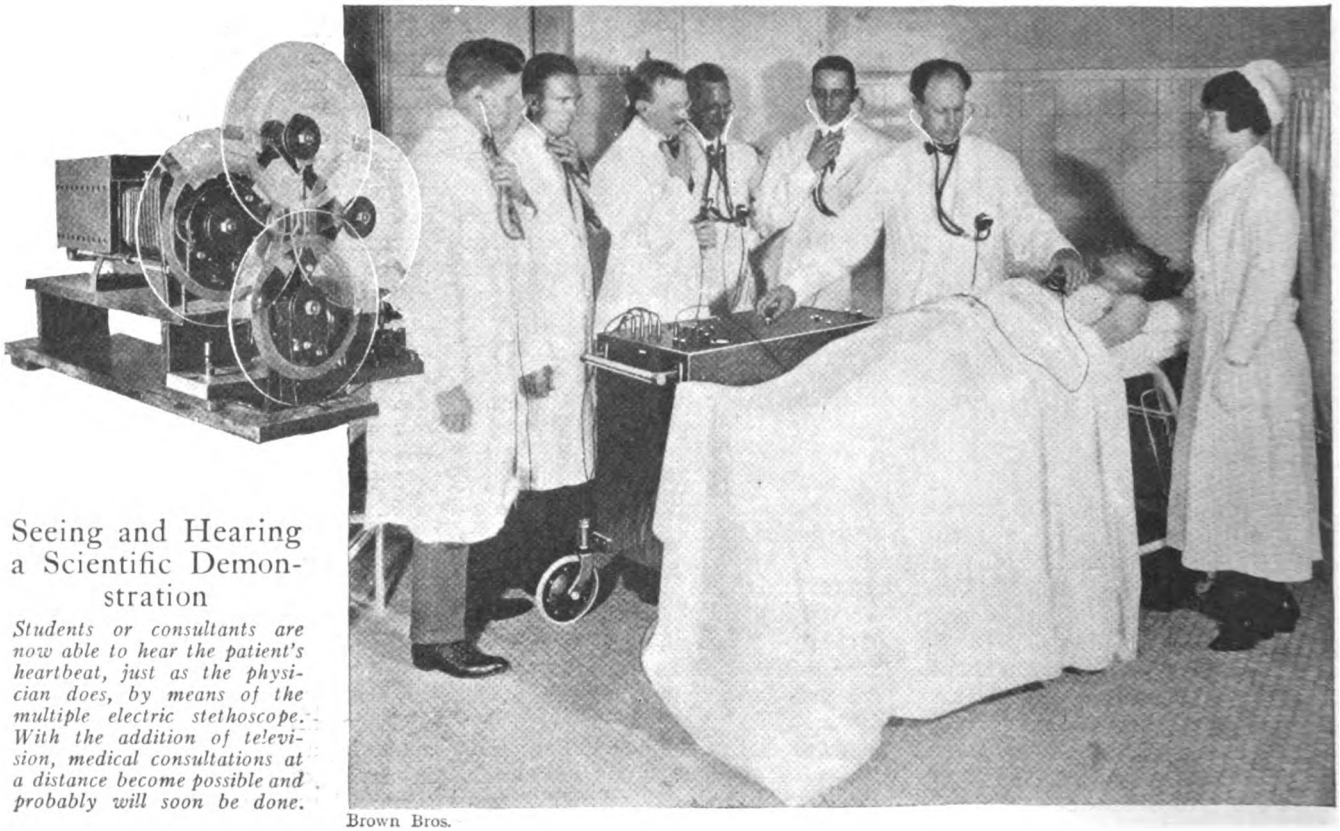
Suppose, for example, that Dr. T. A. Jaggar, the distinguished and adventurous scientist whose job it is to keep watch on the volcanoes of the Hawaiian Islands, decides that one of his temperamental fire-spouters is about to erupt. Not even Dr. Jagger, for all his proven courage and self-sacrifice, would be willing to remain within the crater while the eruption was happening. It would be useless to do so, for he could never return with the record of things seen.

But suppose that Dr. Jaggar installed, in some convenient niche close to the point of danger, the transmitting eye of a television machine. Seated safely in his laboratory miles away, with his seismographs and other instruments conveniently at hand, the Doctor could watch each stage of progress of the eruption until it became so utterly violent that the apparatus was destroyed. At the sacrifice of one television transmitter, costing perhaps a few hundreds or even a few thousands of dollars, it would be possible to obtain information concerning volcanic eruptions which, it is true, a human eye might see but which no human brain could survive to record and bring back.

There exist, also, places on earth which we cannot visit, not so much because they are dangerous as because they are inaccessible. Perhaps the most interesting of these is the bottom of the deep sea, five or six miles below the waves. Great vessels equipped with powerful dredging apparatus and manned by scientific experts have brought up from these abysmal depths a few samples of very curious creatures. Some of these depth-dwellers wear little lanterns, equipped with light like that of the fireflies. Thus they find their way around and lure their food. On the sea bottom there walk some curious crab-like creatures equipped with long legs like stilts. Scientists imagine that these stilts are necessary because the sea bottom is covered with a thick layer of slime which is never disturbed. Ordinary short-legged creatures would sink into this mire and die.

It is improbable that a living man will ever be able to visit these great depths of the sea. The pressure of the water there reaches the enormous total of nearly twelve tons to the square inch. The living creatures who inhabit this strange realm of life are permeable to the water, so that the pressure goes right through them and is without effect. This

(*Continued on page 579*)



Seeing and Hearing a Scientific Demonstration

Students or consultants are now able to hear the patient's heartbeat, just as the physician does, by means of the multiple electric stethoscope. With the addition of television, medical consultations at a distance become possible and probably will soon be done.

Brown Bros.

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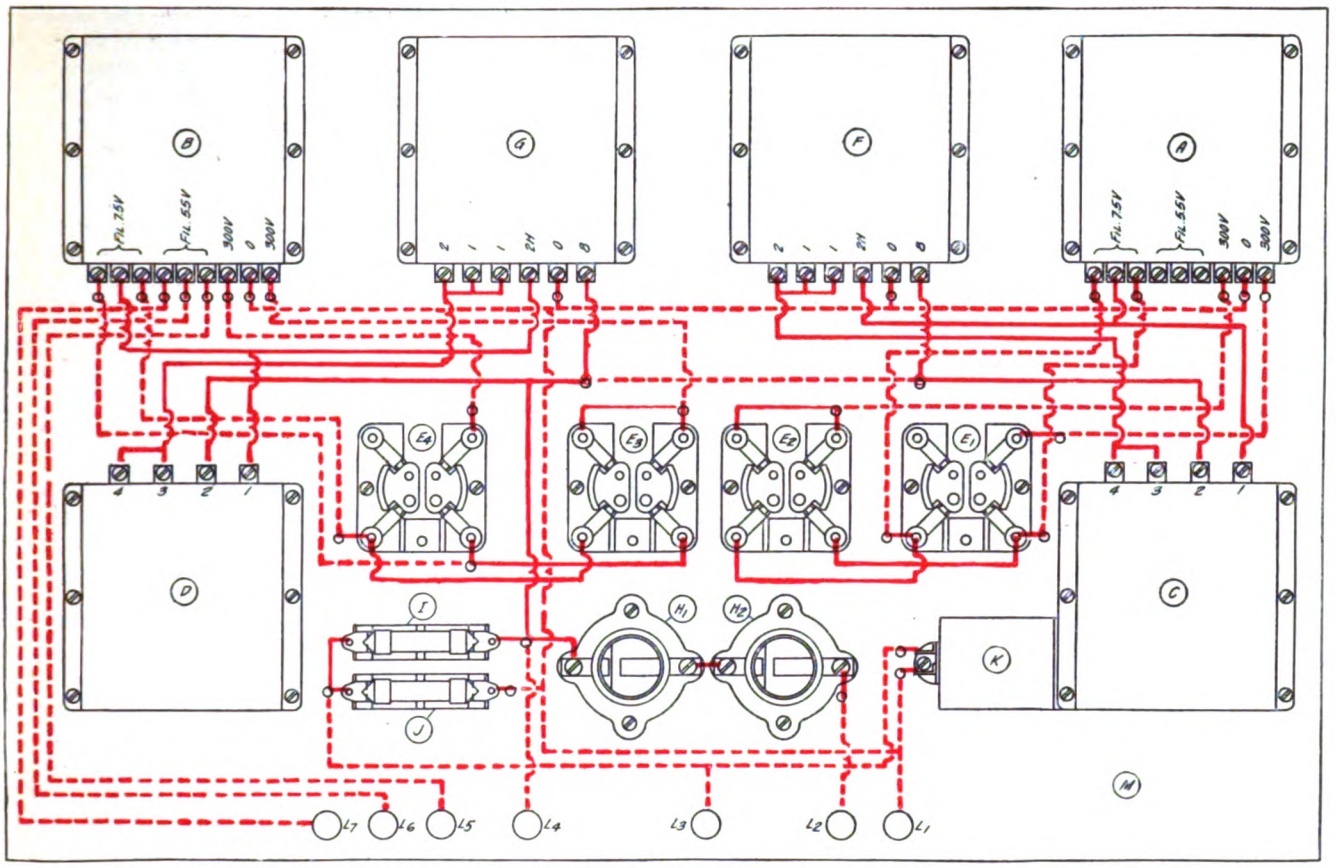

A PICTURE WIRING DIAGRAM OF THE "ABC" POWER-PACK

FIGURE 1: *In this chart the instruments are outlined in* BLACK; *the solid* RED *lines indicate the wiring to be done above the baseboard and the dotted* RED *lines the wiring to be done under the baseboard.*

HOW TO BUILD

A Power-Pack for Browning-Drake Receivers

Here is a new way to operate your Browning-Drake set without *any batteries at all* by means of series filament wiring on standard valves. Four rectifier valves are employed to furnish a current of 250 milliamperes, so that the "A," "B" and "C" voltages in a five-tube set may be obtained directly from the 110-volt, 60 cycle AC current lighting lines.

By GLENN H. BROWNING and DR. FREDERICK H. DRAKE

COST OF PARTS—*Not more than $101.00*

HERE ARE THE PARTS USED IN THE LABORATORY MODEL OF THE POWER-PACK—

A and B—National power transformers;
C and D—National filter choke coils, type 80;
E1, E2, E3 and E4—Airgap UX-type sockets;
F and G—Tobe high-voltage B block;
H1 and H2—Benjamin porcelain cleat receptacles, No. 9401;
I—Tobe high-current resistor, 7,500 ohms, equipped with any approved resistance mounting;
J—Tobe high-current resistor, 5,000 ohms, equipped with any approved resistance mounting;
K—Tobe paper condenser, 400 volts, 4 mfds.;
L1, L2, L3, L4, L5, L6 and L7—Any approved binding posts (Eby posts illustrated);
M—Wooden baseboard, 11⅜ by 20¾ by ½ inch;
N1 and N2—Wooden strips to support the baseboard, ¾ by ¾ by 11⅜ inches.

AS every broadcast listener knows, there are now several methods of operating a radio receiver by merely plugging in on the electric lighting lines for the necessary power.

Some of these methods are eminently satisfactory—and some are not so good.

There are a number of reasons for the failure of some of these methods.

The most successful and therefore the most common method of operating the receiver from the light socket involves the use of a storage battery in combination with a suitable trickle charger for the "A" supply, while the "B" supply is obtained from a "B" power-pack. The only attention that the listener need give to this combination is to supply the stor-

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age battery with distilled water occasionally.

Another form of alternating current "A" supply used with a "B" power-pack consists of a rectifier combined with a filter system to convert the alternating current to direct current. The initial cost of this apparatus is practically the same as that of a storage battery with a trickle charger. Generally, however, this method is not as satisfactory.

A third method of obtaining power from the light lines involves the use of UX-199 type valves that take a filament current of only .06 of an ampere (60 milliamperes). The filaments may be connected in series and the current from the output of the "B" power-pack may be passed through them. This method really does operate entirely from the light current without the use of batteries, but it has one serious draw-back: the plate current drawn by ordinary sets varies somewhat in its values. The plate current passes through the filaments of the UX-199 type valves and if it happens to increase much above 60 milliamperes, the vacuum valves become "flashed" or paralyzed in a short time. A milliammeter may, of course, be used and an adjustment made from time to time. In fact, a meter is an essential part in this type of a receiver if satisfactory operation is to be obtained for any length of time. This method is not to be altogether condemned, even though it is not entirely satisfactory with the present 60 milliampere valves.

Another method suggested to the writers by Mr. Milton B. Sleeper incorporates the principle of filtering a rectified current of 250 milliamperes to supply the filaments of UX-201-a type valves.

This idea has been tried at various times, only to reveal that the apparatus necessary was ordinarily too bulky and expensive. Mr. Sleeper's solution to this problem, however, was to filter two currents of 125 milliamperes separately with two filter systems, to combine the output, and thus obtain the necessary current for operation with UX-201-a type valves. A number of manufacturers make power transformers and filter chokes which are built to pass 80 milliamperes and most of these will pass 125 milliamperes without serious overloading.

This method has drawbacks: one of them is the initial cost; on the other hand, it does away with the disadvantages due to line voltage variation, for a variation of 10 milliamperes means little when compared to the 250 milliamperes which are taken by the filaments of the tubes. It also allows the use of the more powerful UX-201-a type valves in the low-frequency amplifier as well as a sensitive UX-200-a type valve for the detector. These tubes, with a UX-171 type valve for the last stage, make a desirable combination, no matter what type of power supply is used. As the UX-171 type tube takes 500 milliamperes, its filament should be heated from a step-down winding on the power transformer.

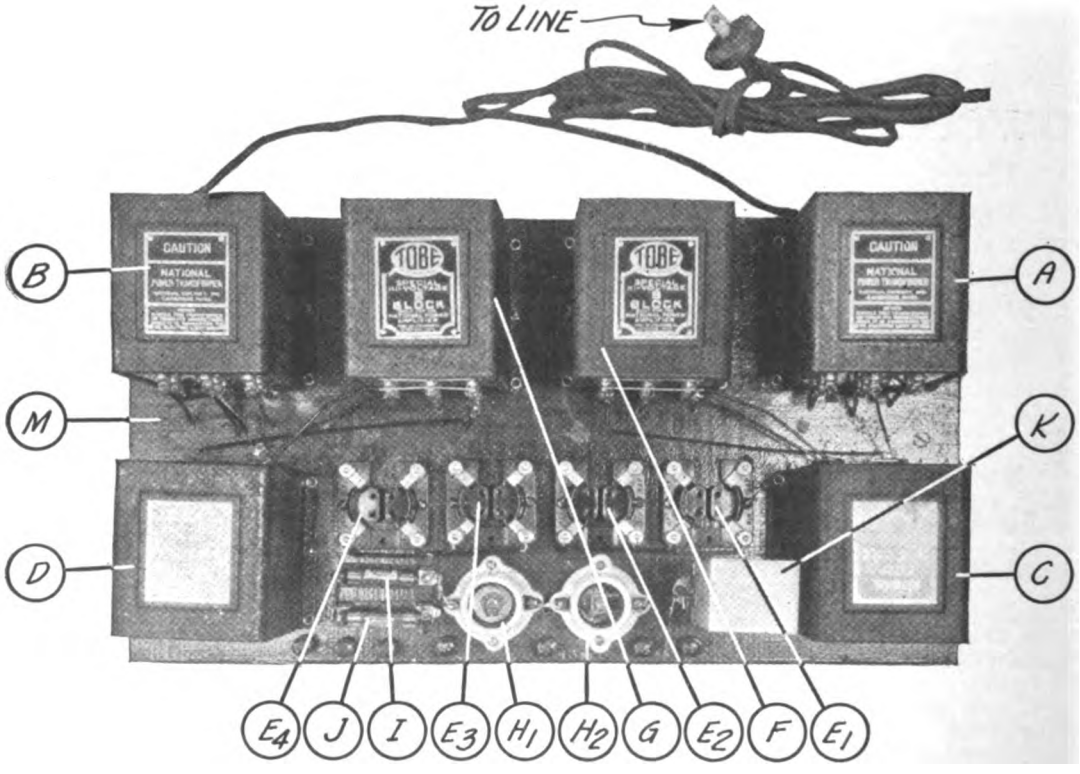
Taken all in all, the new "ABC" power-pack when used in conjunction with the standard Browning-Drake receiver will give excellent results and will always be ready for operation with practically no upkeep worries, adjustments or renewals.

How to Construct the Power-pack

First of all, prepare the baseboard, M, as shown in Figures 1 and 2. It should be cut to a size of 11-⅜ by ½-inch. Across the bottom of each end a ¾-inch strip of wood should be fastened to raise the bottom of the baseboard off the table when in operation. These may be attached as shown in Figure 3.

Next, mount the power transformer, B, in the position indicated in Figure 1. Then mount the two condenser blocks, F and G, and the second power transformer, A. These are all mounted in a line and spaced evenly, as shown in Figures 1 and 2.

Next, mount the two filter chokes, C and D, at opposite ends of the board, as shown in Figure 1. The four sockets, E1, E2, E3 and E4, should then be



A VIEW OF THE "ABC" POWER-PACK FROM ABOVE

FIGURE 2: *This view shows the neat layout of the instruments of the power-pack. The high-voltage blocks, A and B, are plainly marked. Other parts are designated with letters that correspond with the text and the list of parts at the beginning of the article.*

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mounted in a row in the space between the two filter chokes. The mountings for the two resistances, I and J, may next be attached to the baseboard. Then mount the two lamp receptacles, H1 and H2. The last instrument to be attached is the condenser, K, whose position is shown in Figure 1.

As there is no critical adjustment of the locations of the components of this apparatus, no measurements have been given in the drawings; as long as the parts are placed in approximately the positions indicated, operation will be found satisfactory.

How to Wire the Unit

In wiring the unit all that is necessary is to follow the picture wiring diagram in Figure 1. In this figure the colored lines represent the wiring and the black lines the outlines of the instruments. Where the colored lines are dotted they indicate connections beaneath the base, M. The small circles outlined in black through which the colored line goes indicate the spots where a hole should be drilled in the base-board and the wires led through.

The experienced fan who is interested in the theoretical circuit may consult Figure 7 which gives the electrical circuit symbolically.

The diagrams are so simple that a further discussion is unnecessary. For wiring, use either solid insulated bus wire or a flexible wire, such as "Celatsite."

How to Change over the Browning-Drake Receiver

In order to rearrange the circuit of the receiver described in the April, 1927, issue of POPULAR RADIO for operation with the ABC power-pack, only a few minor changes need to be made, provided that the constructor has wired the receiver according to the directions given in the earlier article. Here are the changes to be made:

1. Connect the filaments of the first four vacuum valves, F1, F2, F3 and F4, shown in Figures 4 and 6, in series. Include in this series connection the lights for the dials.

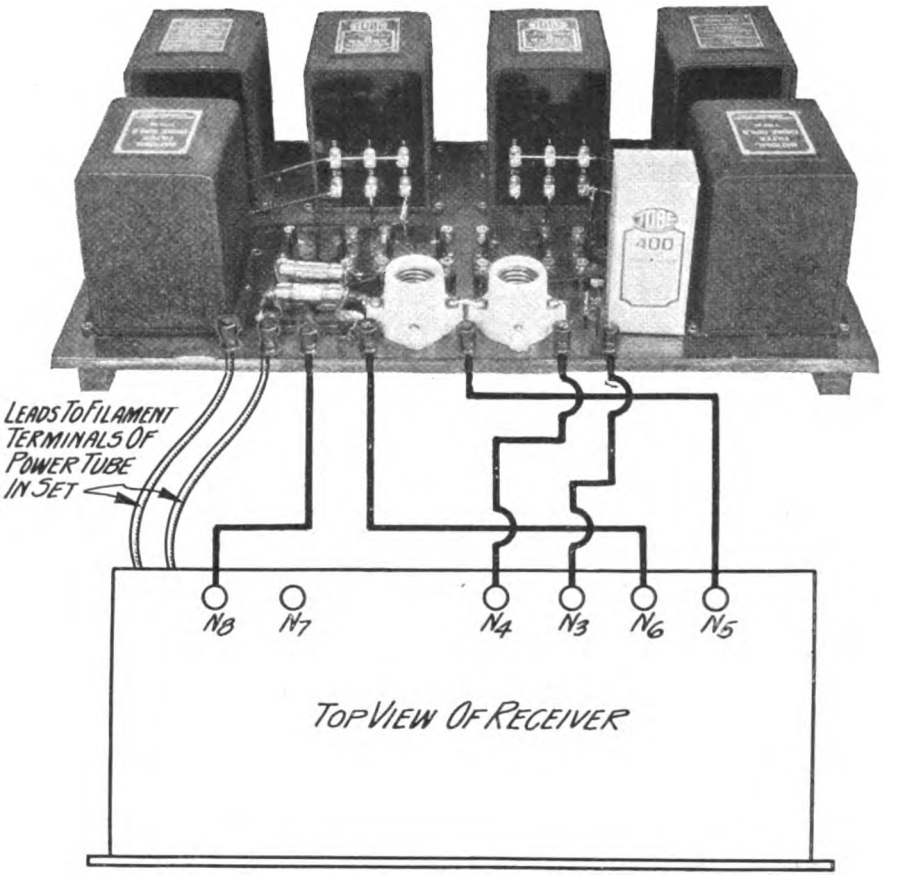
2. Connect the 33-ohm resistance, T, and the 30-ohm rheostat, V, in parallel with the first vacuum valve, F1. A drop of solder should be attached to the 30-ohm rheostat so that it can never be turned completely "off." This rheostat then acts solely as a volume control except that decreasing the resistance now will *decrease* the volume; with the other arrangement it *increased* the volume.

3. Remove the 1¼-ampere automatic filament control, U, from its mounting and in its place insert an Aerovox 2,000-ohm Lavite resistance. Rewire this unit as shown in Figures 4 and 6.

4. Disconnect the filament of the last vacuum valve, F5, and solder on two long leads that can go directly to the 5½-volt winding of one of the power transformers of the power-pack.

5. Eliminate condensers, K1 and K3, from the circuit.

All of these connections and changes are clearly shown in Figures 4 and 6 and if the builder follows directions carefully he will find no trouble in wiring up.



HOW TO HOOK UP THE TWO UNITS

FIGURE 3: *This picture shows the connections between the receiver and the new power-pack. Four UX-216-b valves must be placed in the vacuum-valve sockets. Also place a 50-watt electric light bulb in the left-hand porcelain socket, shown in front part of the power-pack above, and a 25-watt electric light bulb in the right-hand porcelain socket.*

The method of hooking up the new power-pack to the receiver is indicated very clearly in Figure 3.

These changes may be made in less than an hour by the average set-builder. The operation and tuning of the receiver follow exactly the same methods as before described, except that the receiver should be always turned "on" and "off" by means of a switch in the 110-volt, 60 cycle AC line; otherwise valves may be damaged by high-voltage surges.

The writer has found this method an interesting and practical solution of the problem of operating a receiver without the use of "A," "B" or "C" batteries.

¶ *The list of parts given on page 523 includes the exact instruments used in the unit from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

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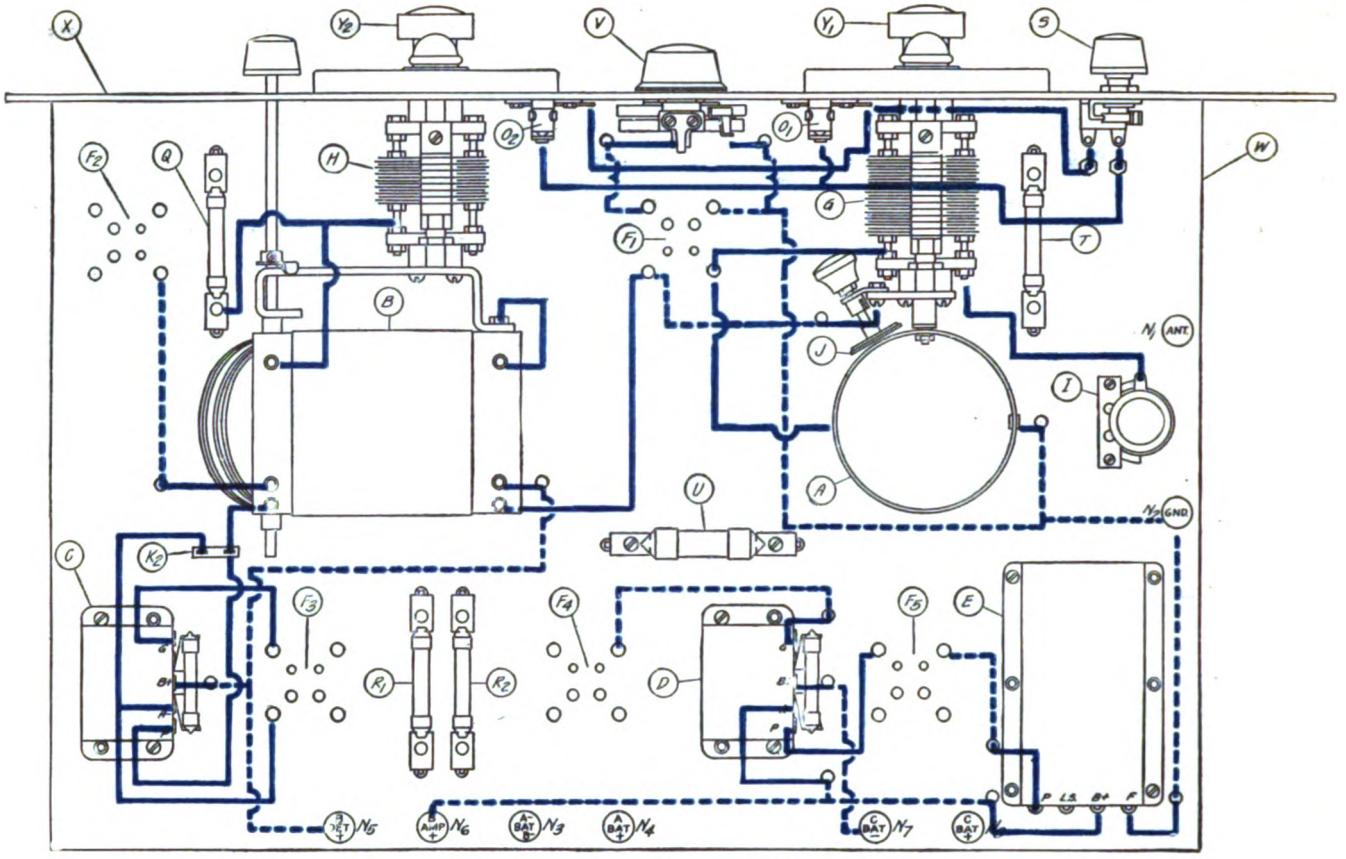
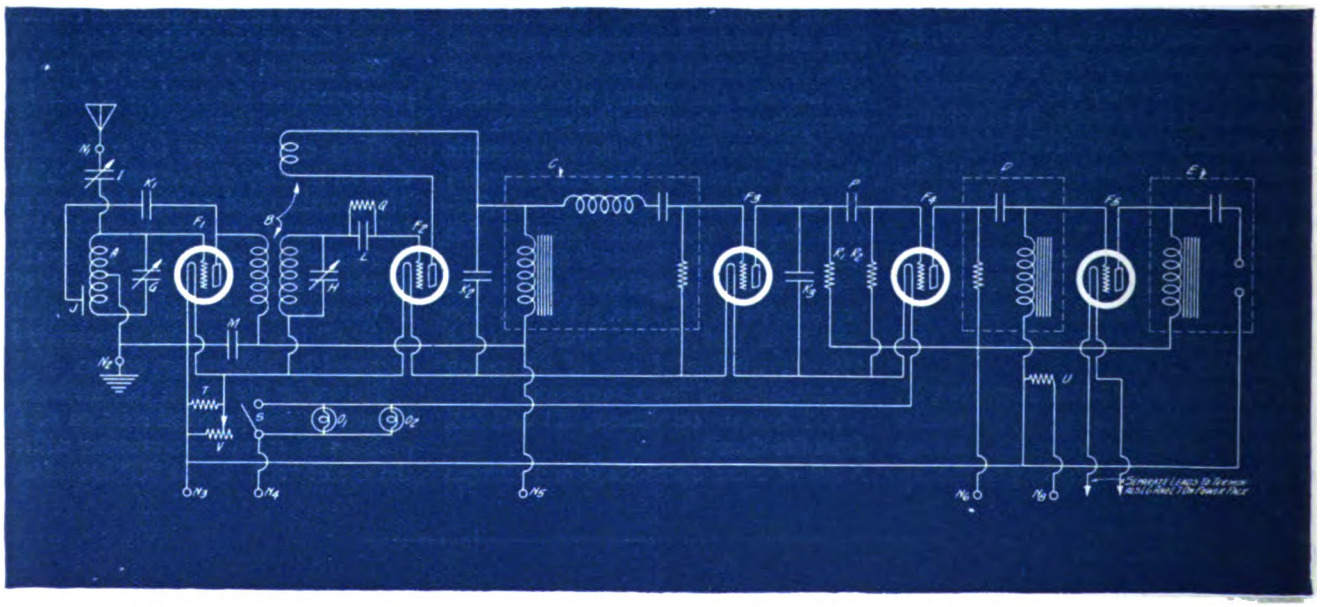


THE PICTURE WIRING DIAGRAM FOR THE TOP OF THE REVISED BROWNING-DRAKE RECEIVER

FIGURE 4: *This drawing gives the changes in the wiring of the standard Browning-Drake receiver, described in the April issue of* POPULAR RADIO, *to permit its use with the power-pack described in this article. The changes may be easily made within an hour. The solid* BLUE *lines indicate the wires above the panel; small holes outlined in* BLACK *show where these wires go through the panel; dotted* BLUE *lines indicate the continuation of the wiring under the panel.*



THE SCHEMATIC DIAGRAM OF THE REVISED BROWNING-DRAKE CIRCUIT

FIGURE 5: *Here is the electrical circuit of the Browning-Drake receiver as wired up for operation with the "ABC" power-pack. A comparison of this diagram with the schematic diagram of the standard Browning-Drake receiver in the April issue of* POPULAR RADIO *will show that the changes do not affect the electrical characteristics of the circuit.*

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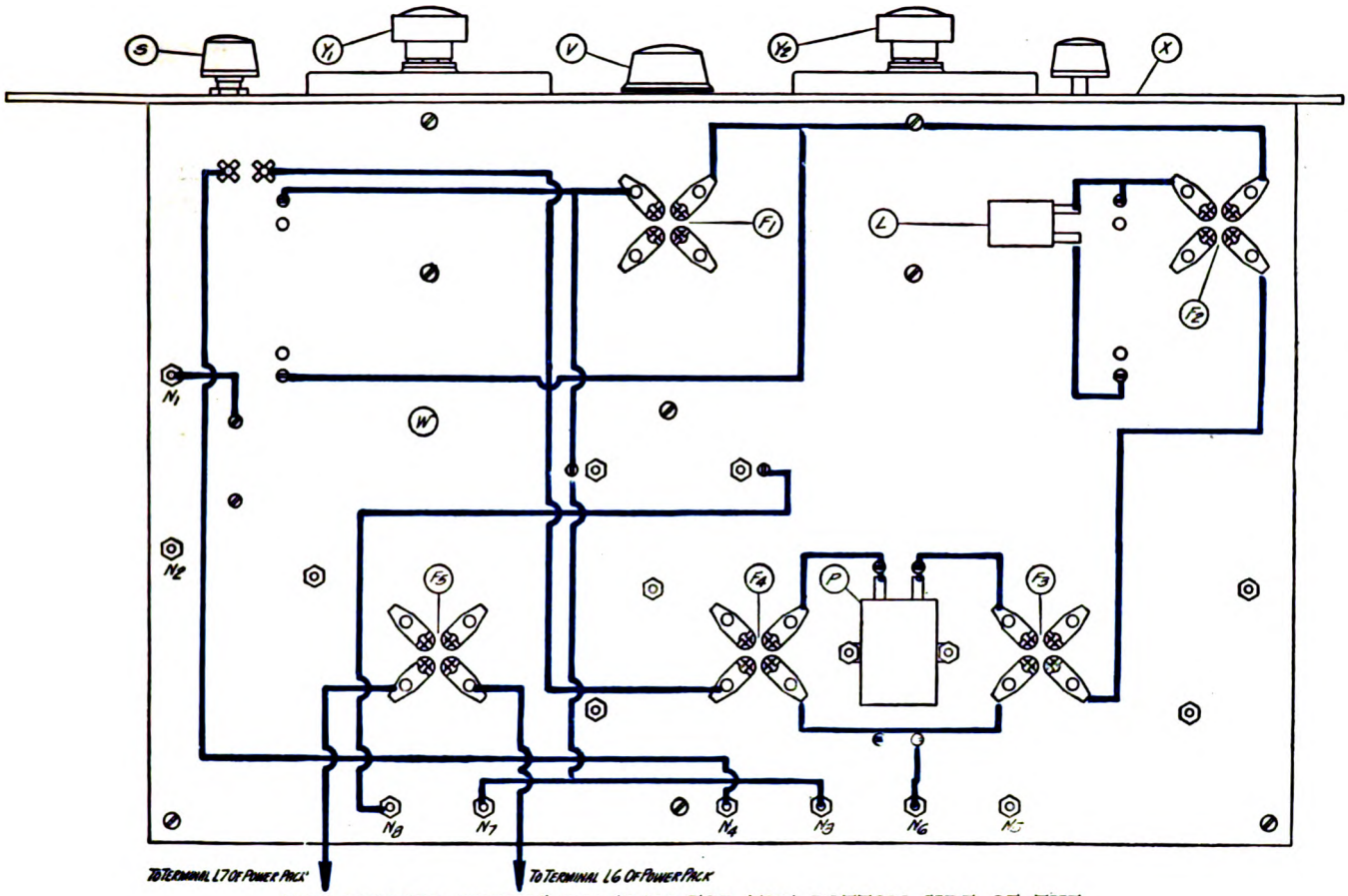
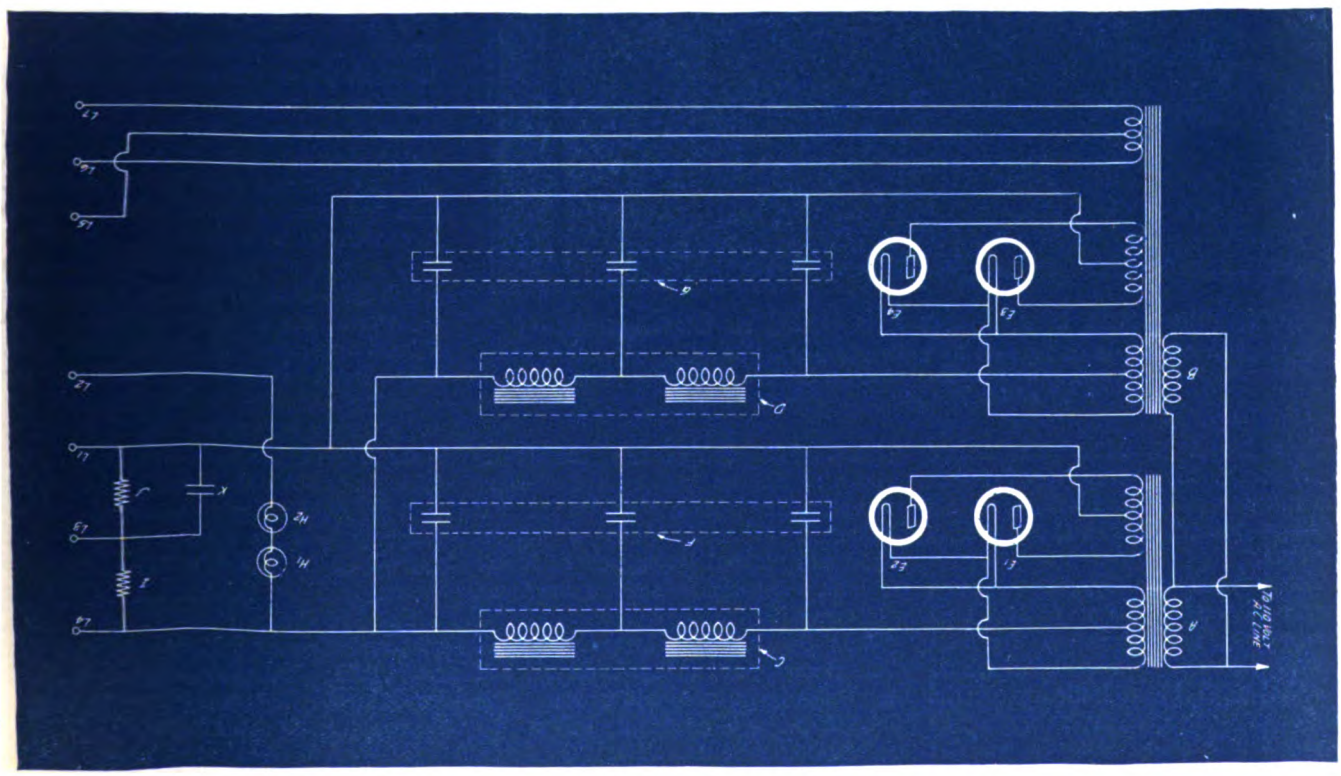


THE REVISED WIRING DIAGRAM FOR THE BOTTOM SIDE OF THE BROWNING-DRAKE RECEIVER

FIGURE 6: *In this diagram the* BLUE *lines indicate the wiring to be done on the under side of the Browning-Drake receiver shown in* FIGURE 4.



THE SCHEMATIC DIAGRAM OF THE POWER-PACK

FIGURE 7: *Here is the electrical circuit which the "ABC" pack employs to furnish the power for the Browning-Drake receiver. Notice the two separate filter systems employed.*

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The "SECRETS" OF THE

The significance of the successful tests to cast spells via the microphone and science's answer to the question, "Can the broadcast listeners be hypnotized by radio?"

By E. E. FREE, Ph.D.

The Hypnotist Broadcasts His Spell in Springfield—

The experiment in hypnosis by radio was undertaken by Mr. Gerald M. P. Fitzgibbons, a well-known hypnotist, in the broadcasting studio of station WBZ in Massachusetts.

ON March 9, 1927, Mr. Gerald M. P. Fitzgibbons stood before the microphone of broadcasting station WBZ at Springfield, Mass., and evoked the past.

Thirty years ago hypnotism was a household word. The world had been shocked by "Trilby," first of the "best sellers," the saga of the pathetic artist's model, beautiful but frail, and of the all too magnetic eyes of the mysterious Svengali. In every town in America amateur Svengalis tried to follow the instructions in booklets labeled, "How to Be a Hypnotist"; itinerant practitioners of the art astonished the attendants at Chautauquas and lecture courses; dinner-table conversation was enlivened with such words as "suggestion" and "animal magnetism" as it now is with "vibrations" and "waves" and "electrons."

The Spanish War came and went. The pocket puzzle, Pigs-in-clover, and the Ouija board were laid to rest. The tandem bicycle vanished before the newly invented automobile. Hypnotism lost the favor of the fickle public and psycho-analysis, trailing wisps of foggy language called "complexes" and "suppressions." came to take its place.

Now Mr. Fitzgibbons has brought hypnotism back, if only for a day. His experiment over the wave of WBZ was an experiment in radio hypnotism.

Standing at the microphone, he spoke over the ether the words intended to induce the hypnotic spell. Listening at the Hotel Brunswick, in Boston, were three men. Two of these men the hypnotist had expected; the third man was present without prearrangement.

Two physicians, Dr. A. Warren Stearns and Dr. Clarence A. Bonner. both of Boston, were present to observe the experiment. The two subjects present by prearrangement passed under the hypnotic influence when the magic words came over the radio, although not with a perfection fully satisfactory to the physicians. The third man, present without Mr. Fitzgibbons' knowledge, was quite unaffected by the hypnotic words. A few other persons who listened to the experiment over their own receivers report that they felt drowsy; as no doubt radio listeners sometimes do at programs even more interesting, so these reports may be disregarded. The first recorded experiment in radio hypnotism came to an end.

If newspaper reports and the inquiries which have come to me are typical, the experiment seems to have been considered something of a marvel. Not only is it deemed astonishing for hypnotic influence to be exerted by radio, but a proportion of individuals seem to feel that a new danger has been let loose on the radio world—the danger that the minds of listeners may be seized suddenly by some radio hypnotist and carried off by him into foolishness or worse.

This last is as nonsensical as was the supposed hypnotic influence of Svengali over Trilby. No person with a mind worth stealing is going to lose it to any hypnotist, radio or otherwise.

Even minds that are not really worth carrying away are perfectly safe from this attack, for it is recorded that idiots are among the few kinds of people

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HYPNOTIST BY RADIO

Henry Miller

—and Hypnotizes Two of the Three Subjects in Boston

In station WBZA, two experimenters (both of whom had been previously cast under spells by Mr. Fitzgibbons) responded to the hypnotist's suggestions; the third experimenter did not. In the picture above Dr. C. A. Bonner and Dr. A. Warren Stearns are sticking needles into the two subjects to test the extent of the hypnosis.

seldom hypnotizable, even with their own consent.

Nor is the experiment of radio hypnotism any special marvel except as all mental phenomena are really marvelous when one digs deeply enough into them. Any psychologist familiar with the facts of hypnotism could have predicted that the Springfield experiment would come out exactly as it did. The persons formerly hypnotized by Mr. Fitzgibbons and expecting to have it happen to them again would drop off to sleep. Other persons, not prepared by previous hypnotism or by expectation, would be immune.

While I can find no record of a previous instance in which the signal to drop asleep was passed from hypnotist to subject by radio, that is merely because no one thought of using it. Hypnotists have sent such sleep messages by letter and by telegram, by the word of mouth of other persons, even by such purely impersonal signals as the striking of a clock or the whistle of the postman. As long as forty years ago the French psychologist, Liégeois, sent his subject into the hypnotic state by speaking to him over the telephone from a distance of several miles; truly a marvelous feat, the French telephone being what it still remains, but wonderful telephonically, not hypnotically.

There is not the slightest difficulty about producing hypnosis at a distance provided two conditions exist: one is the willingness of the subject, the other is that that subject shall have been hypnotized previously by the same hypnotist and shall have been prepared by him for the later event.

The still more marvelous-seeming feat of causing a subject to fall asleep spontaneously at a certain hour or signal, without any action at all by the hypnotist, is equally a commonplace of the hypnotic operating room. It is done by what is called post-hypnotic suggestion.

Everyone is familiar, even now when it is less often a means of public entertainment than it used to be, with the procedure of ordinary hypnosis. The hypnotist makes a few passes, murmurs a few words or gently strokes the subject's head. The subject falls into a deep sleep in which he is blind, deaf and senseless to all outside *stimuli* except those coming from the hypnotist.

The hypnotist says: "You are falling in an elevator."

The subject instantly shows every sign of severe fright. On the signal of the hypnotist, the subject will swim ridiculously on the dry floor or growl like a bear or eat paper for ice-cream or accept anything else that the hypno-

(*Continued on page 572*)

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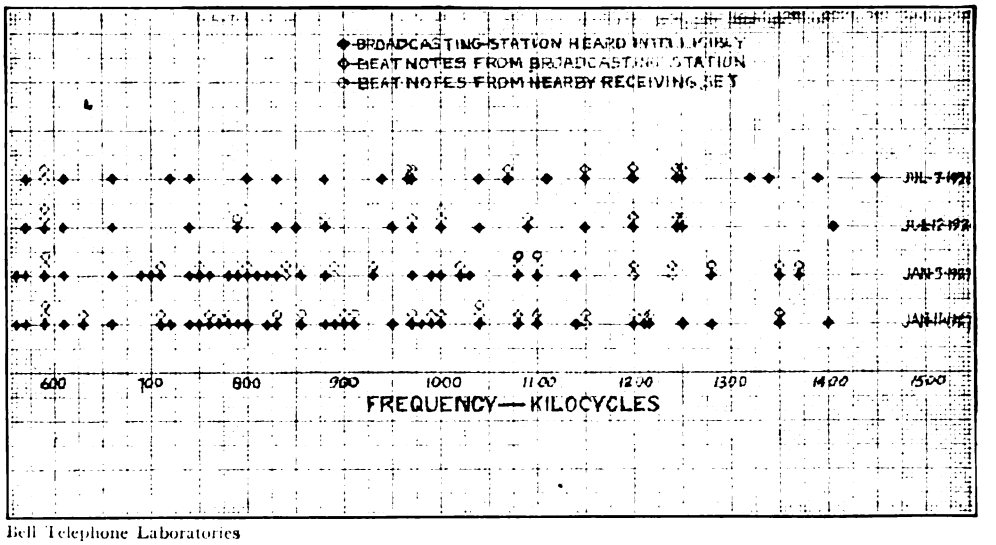

Bell Telephone Laboratories

A COMPARISON BETWEEN SUMMER AND WINTER INTERFERENCE

FIGURE 1: *The first two horizontal lines of designations were made in July, 1926, the last two in January, 1927. Although the number of stations heard during the winter tests was greater than the number heard in the summer tests, due to better reception conditions, the amount of interference also increased.*

"SQUEALS"

What They Are and How to Stop Them

Practical information that every set owner should have on how to free broadcast reception from one of the preventable annoyances.

By E. G. FRACKER

THE greatest afflictions of the broadcast listener are static, spark stations and squeals.

Static is absent or slight most of the time.

Government regulation of wavelengths and schedules has reduced the amount of spark interference.

But during most of the listening hours we are annoyed by a range of noises extending throughout the entire range of frequencies that are audible to the human ear, such as might be produced by a hungry pig family of all ages. And it is with such noises, commonly referred to as "squeals," that we are concerned in this article.

In the pioneer broadcasting days the air was not cluttered up, because but few transmitting and receiving sets were in use. Transmitters operated at widely separated frequencies and crystal detectors were used for receiving. This was detrimental to the propagation of squeals.

Now, however, with the lid off the range of frequencies assigned by the government for broadcasting, the air is burned up nightly by a go-as-you-please competition of hundreds of stations. Although the majority retain the frequencies originally allotted, many have become shifters. The comparatively few crystal sets are practically extinct; they have given way to the more versatile vacuum-tube receivers. Nearly every listener knows that these present day conditions are responsible for the squeals which are his worst radio affliction.

Assuming that the listener's set is incapable of producing these unwanted noises, all his disturbances will be picked out of the air.

An attempt is made to pick up a distant station by setting the dials to positions which previously have brought it in satisfactorily, but nothing is heard but a steady whistle. This is due to the operation of another station differing only a few thousand cycles in carrier-frequency from the desired station, the pitch of the whistle being equal to the difference in frequencies. This is what may be expected when the transmission from both stations is received with approximately equal intensity.

If the station to which the set is tuned be received with greater intensity, it may be possible to distinguish what is being transmitted, but the whistle will be heard so long as the current from the weaker station is sufficient to actuate the detector.

This difference in intensity may be due to the power used for transmission, distance from receiver, intervening atmospheric and land conditions or the tuning of the receiver.

The production of the audio-frequency current which causes this whistle is due to the same property of the detector tube which enables it to change the component frequencies produced by modulation into speech-frequency currents similar to those which originate at the microphone.

To generalize, when any two currents of slightly different frequencies, such as carrier currents from two broadcasting stations, are passed through the detector, they are resolved into a current at a third frequency equal to the difference of the original frequencies, which is the pitch of the tone heard.

This tone is sometimes referred to as a "beat-note" and the combining action producing it is called "heterodyning."

It is possible, on some receiving sets, to receive with good volume two or more stations of different carrier-frequencies

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without hearing beat-notes. This occurs when the frequencies differ by more than the highest audible frequency. Conditions at the receiving set are generally responsible for this. The circuits are not sufficiently selective, either inherently or because of inefficient manipulation. The degree of selectivity also depends on whether the receiver is located near broadcasting stations. In such districts a completely shielded, highly selective circuit is of advantage.

Another external source of squeals is the oscillating receiving set, due to the heterodyning of its oscillating currents with the high-frequency currents radiated by broadcasting transmitters.

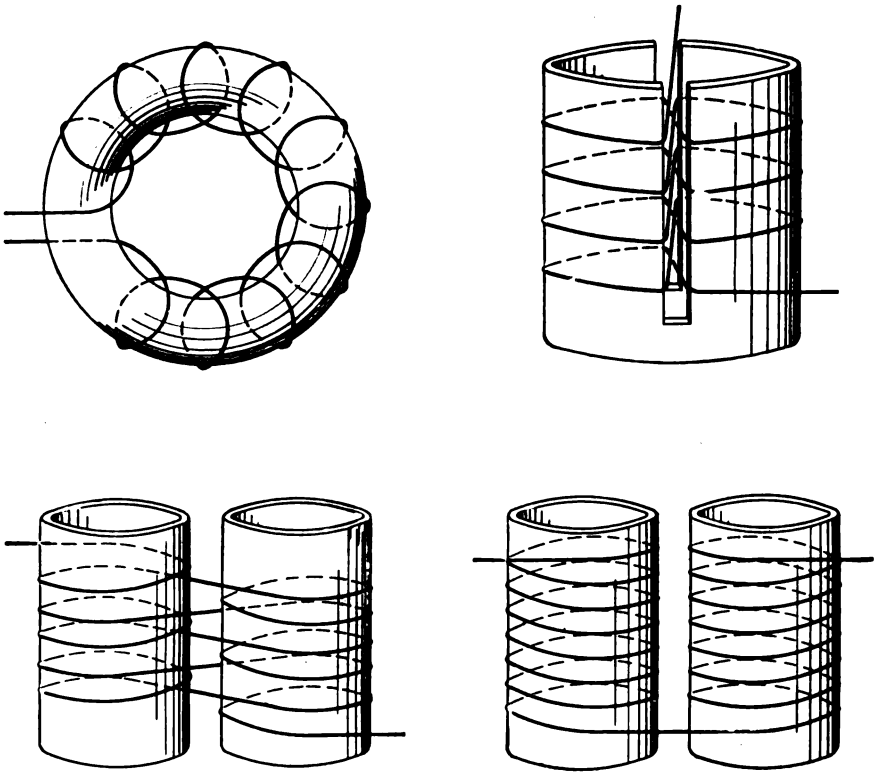
The receivers that may be expected to cause disturbances are regenerative receivers, receivers that have radio-frequency amplifiers improperly arranged to prevent oscillation, and superheterodyne sets in which considerable energy is transferred from the oscillator circuits to the loop or antenna.

All these types may be considered as low-power transmitting stations, as they annoy in much the same manner as a heterodyning broadcasting station. However, the beat-notes produced by receivers are generally variable as a result of changes in the circuit constants and may be identified by this characteristic.

In general, it may be said of oscillating receivers that the extent of their offense is governed by their distance from the listener's receiver and the closeness of coupling between their antenna and oscillating circuits. We should be thankful that they rarely inflict unearthly wails upon other receivers without wailing likewise themselves. Although measures may be employed whereby they may be made self-immune, the less said about these measures the better, lest they be used for revengeful purposes—which would only make matters worse. Besides, kind words and constructive criticism have already proved their worth in eliminating many nerve-racking receivers. Set a good example by using a receiver that reproduces with the utmost fidelity possible; it will be worth more than one hundred 3,000-mile squealers in its ability to furnish high-class entertainment instead of punishment to all members of the family and friends.

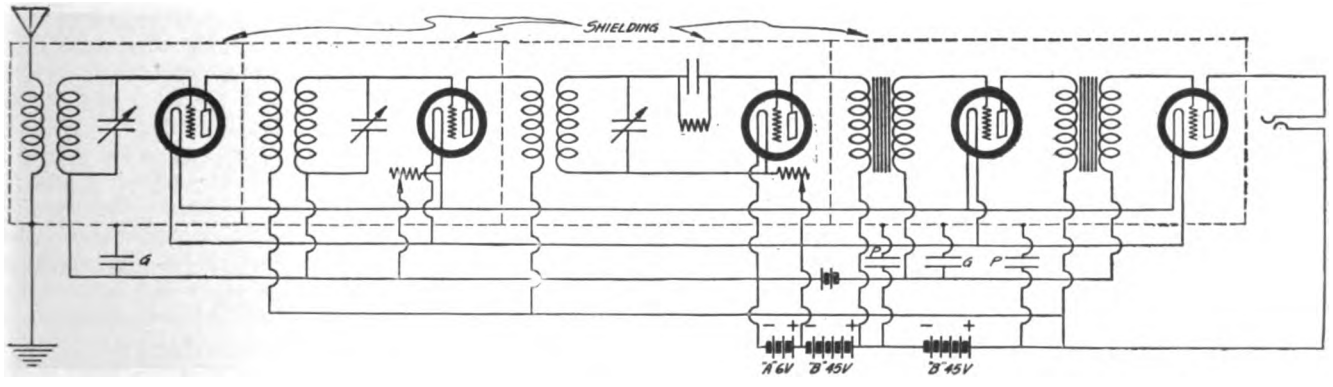
Another source of external squeals, which is but rarely heard, takes the form of telegraphic dots and dashes.

Some of the high-power, long-wave telegraph stations are responsible for them. Although the frequencies at which they transmit are far below those of the broadcasting band, their power is so great that it is possible to receive currents at harmonics of their fundamental frequencies, at a few points on the dial where broadcasting stations are tuned in, and the heterodyning of the harmonic-frequency currents with the broadcasting carrier-frequency currents causes beat-notes to be heard.



COILS WITH LIMITED FIELDS

FIGURE 2: *The coils shown here tend to withhold the electrical fields within the dimensions taken up by the windings themselves. At the top left is shown the toroid coil which has a self-contained field. At the right is the "Figure 8" coil wound on a single slotted tube; on the bottom left is a "Figure 8" coil wound on two tubes; at its right is a so-called binocular coil with the windings in reversed direction on the two tubes.*



SOME OF THE METHODS USED FOR PREVENTING SQUEALING

FIGURE 3: *Make the leads from the grid to the coils and from the plate to the coils as short as possible; employ interstage shielding for each stage of high-frequency amplification; include the low-frequency amplifier in a stage shield; use as many by-pass condensers as are indicated across the batteries and filament circuits.*

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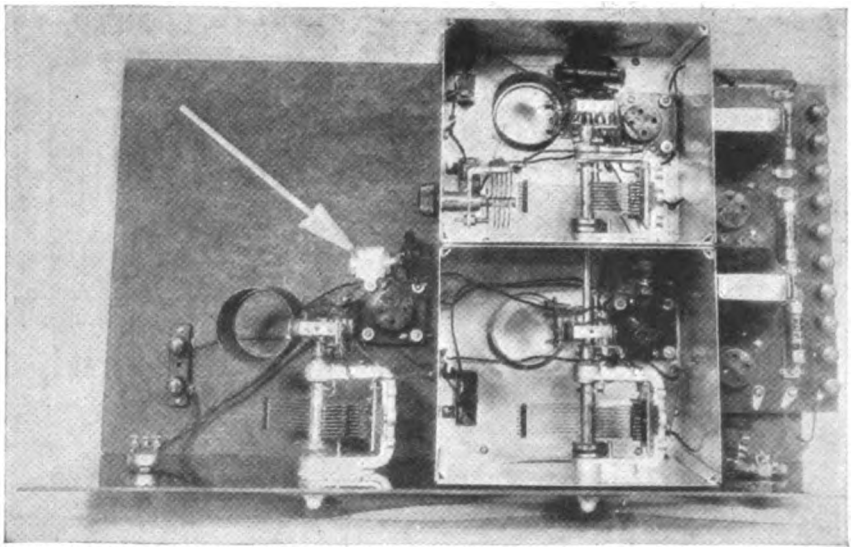


HOW A NEUTRALIZING CONDENSER IS USED TO DIMINISH SQUEALING

FIGURE 4: *In this picture, which is a reproduction of the Hi-Q receiver, the white arrow points to one of the neutralizing condensers. It is used to balance the tube capacity, thus preventing feedback and the consequent oscillation or squealing that would be obtained without the neutralizing condenser.*

An idea of the extent and nature of the various squeals heard may be gained from Figure 1, which shows observations which were made between 9 P. M. and 11 P. M. during four nights.

The first two observations show conditions during last July. The fact that fewer receiver squeals were present on one night was due to the heat and humidity, which tended to discourage all desire for dial manipulation. The two lower observations indicate the revolutionary conditions that existed in January. Allowing for more stations being received because of the more favorable winter atmospheric conditions, it shows that many stations have changed their wavelengths upward.

This congestion between 300 and 400 meters, although objectionable in some respects, is responsible for one worthwhile improvement; it has largely discouraged the desire to hunt for distant stations, which were frequently located by setting the receiver in a state of oscillation. This is indicated by the small number of receiver squeals heard in January, the height of the open season for DX hunter.

Very little progress can be made in eliminating these squeals of external origin. Their volume may be reduced and some may be eliminated by using highly selective receiver circuits. However, if too great a degree of selectivity be obtained, distortion will result from incomplete reception of the side bands.

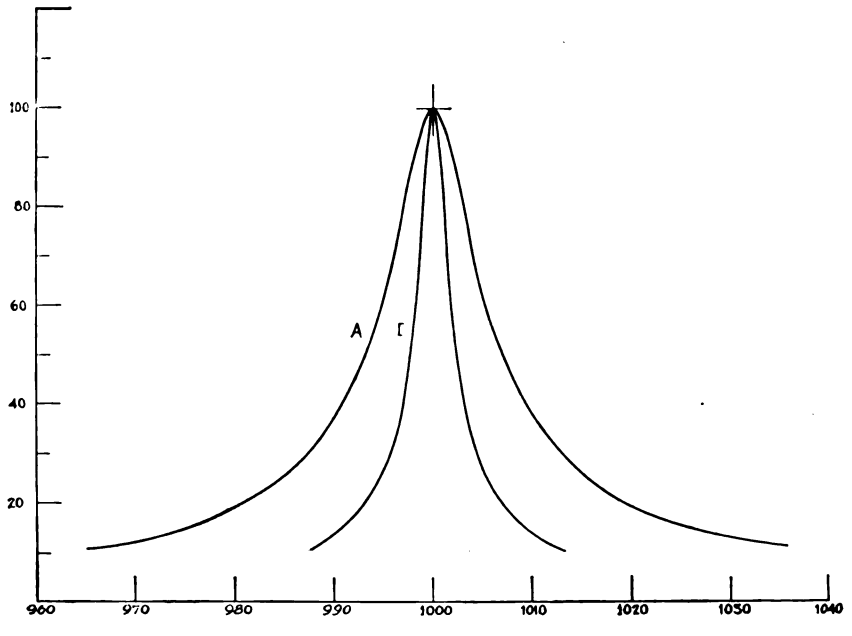
A receiver tuned to 1,000 kilocycles and having a resonance curve as shown at A, Figure 5, will receive about 50 per cent as much from either a 993 or 1,007 kilocycle station as from a 1,000 kilocycle station, assuming equal input to the receiver at resonance in each case.

With the receiver modified so that its resonance curve is as shown at B with the current maintained the same as before for the 1,000 kilocycle station, the current from the other stations will be reduced to approximately 20 per cent and the beat-notes from these stations will be correspondingly reduced in volume. Greater selectivity in a receiver may be obtained by reducing the resistance of the radio-frequency circuits including the antenna circuit and by reducing the coupling to the antenna.

With the squeals that originate within the listener's receiver it is a different matter. They can always be eliminated, although more time is often required to do this than to build the receiver. A sustained audio-frequency tone is generally due to radio-frequency oscillations in the receiver or to feedback at audio-frequencies, often referred to as "singing." A beat-note from a receiver oscillating at only one frequency can be heard only when another oscillating current is present, such as from an incoming signal. If heard without the presence of an incoming signal, the set may be singing at two slightly separated radio-frequencies or else at an audio-frequency.

In radio-frequency amplifier sets, the utilization of interstage transformers makes a potential oscillator of each radio-frequency tube circuit, due to the coupling through the tube capacity which permits an interchange of energy between the grid and plate inductances (as shown in Figure 7) unless some means is adopted to prevent oscillation. This may be accomplished by reducing the plate in-

(Continued on page 574)



A COMPARISON OF A SHARP AND BROAD RESONANCE CURVE

FIGURE 5: *The tuning curve shown at A includes a wider band of frequencies than the one shown at B. A receiver with a curve similar to B will not be affected by interfering stations to as great an extent as the one with a curve similar to that shown at A. Greater selectivity may be obtained by reducing the resistance of the high-frequency tuning circuits.*

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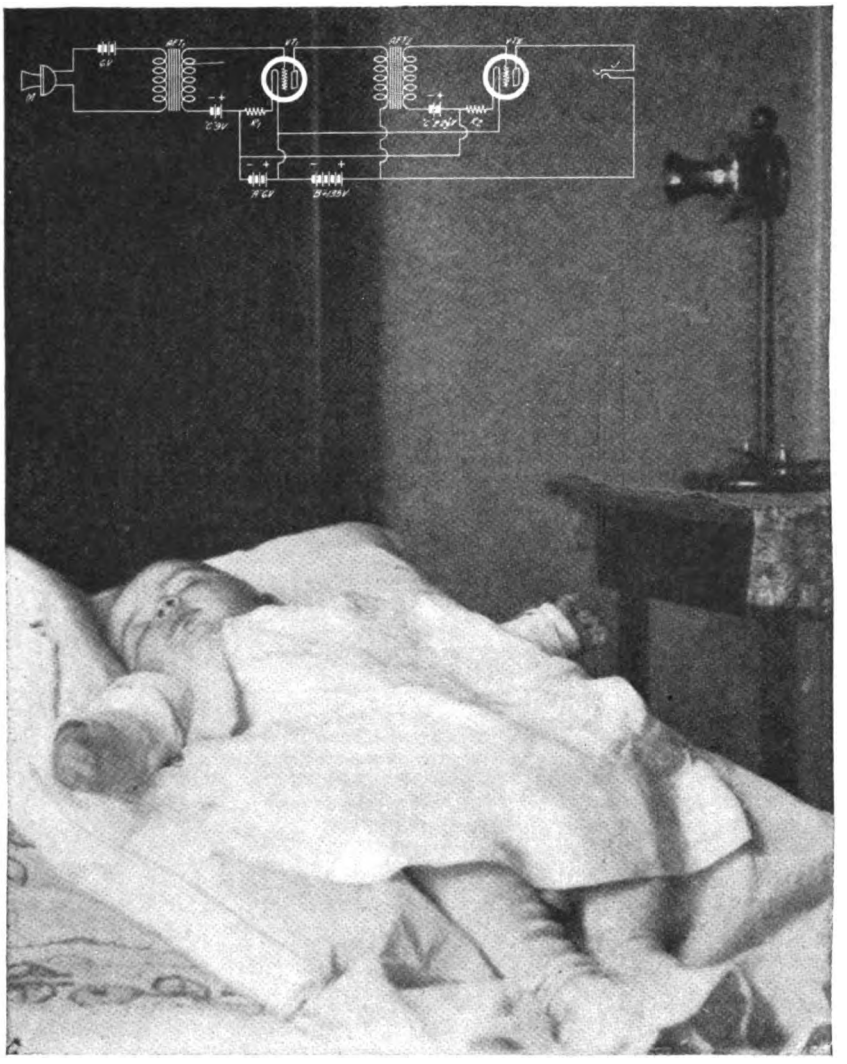

A TIP FROM ONE RADIO FAN

Here is a practical, labor-saving suggestion for the household that contains a baby—and a mother who has housework to do.

"This Is Station WAIL Calling"

By MABEL WHEELER

HERE IS A LIST OF PARTS REQUIRED FOR THIS HOOK-UP—

Microphone;
2 high-grade low-frequency transformers;
2 open-circuit jacks;
2 UX type sockets;
2 rheostats or automatic filament controls;
1 filament switch;
Bakelite panel, 7 by 14 inches;
Baseboard, 8 by 12 inches;
1 UX-112 type valve;
1 UX-171 type valve (in the last stage of amplification);
Proper length of No. 16 bell wire.

OUT in Indianapolis there lives a young lady—ten months old, to be precise—who has a private broadcasting station all her own. Also, she does all of the broadcasting herself. Her warbling is not for the general public, however; only members of her own family and guests get the benefits of the broadcaster's treble voice.

The special call letters of the station are, according to the family, WAIL, but they are not registered.

The small broadcaster's name is Patricia Jenkins.

It all came about in this manner:

Miss Patricia has her bed in the nursery on the second floor of her home. When the rest of the family were downstairs talking, or listening to the radio or the piano, it used to be impossible to hear the baby cry when she wakened from her naps. So Mrs. Herbert Jenkins, the baby's mother, or Mrs. Charles Pickerill, the baby's grandmother, used to make numerous trips up the stairs on false alarms, thinking they heard the baby's cries.

Finally Mr. Jenkins decided that all this bother should be eliminated, so he conceived the idea of broadcasting Pat's cries through the house. He installed a microphone (later replaced by a telephone transmitter), so that each wail from Pat's crib would be broadcast through the house. Two stages of amplification were used, and a loudspeaker was installed downstairs.

Now even the gentlest wail of Patricia comes rushing out from the speaker like the roar of a lion; her every cough or sigh is wafted loudly and clearly to the family below.

Now mother and grandmother go about their work without a tremor of nervousness. For they know that her waking will be instantly made known to them above all other noises.

The diagram of the circuit used is shown in the accompanying illustration and the list of parts necessary to duplicate this device is given above.

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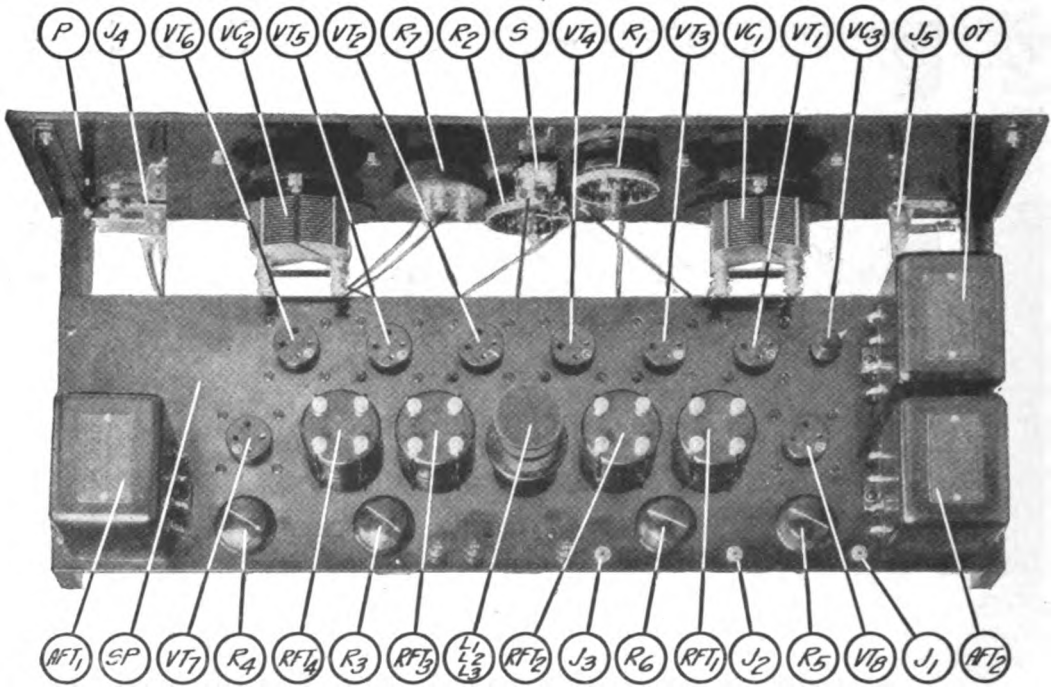


The Lincoln Superheterodyne Receiver

Stations come in at only one setting of the dials in this new superheterodyne receiver; extraneous noises have been reduced to a minimum by its design. The low-frequency amplifier is excellent; it is followed by an output filter to keep heavy currents out of the reproducer. The set is easy to tune and is ideally suited for use with a power-pack.

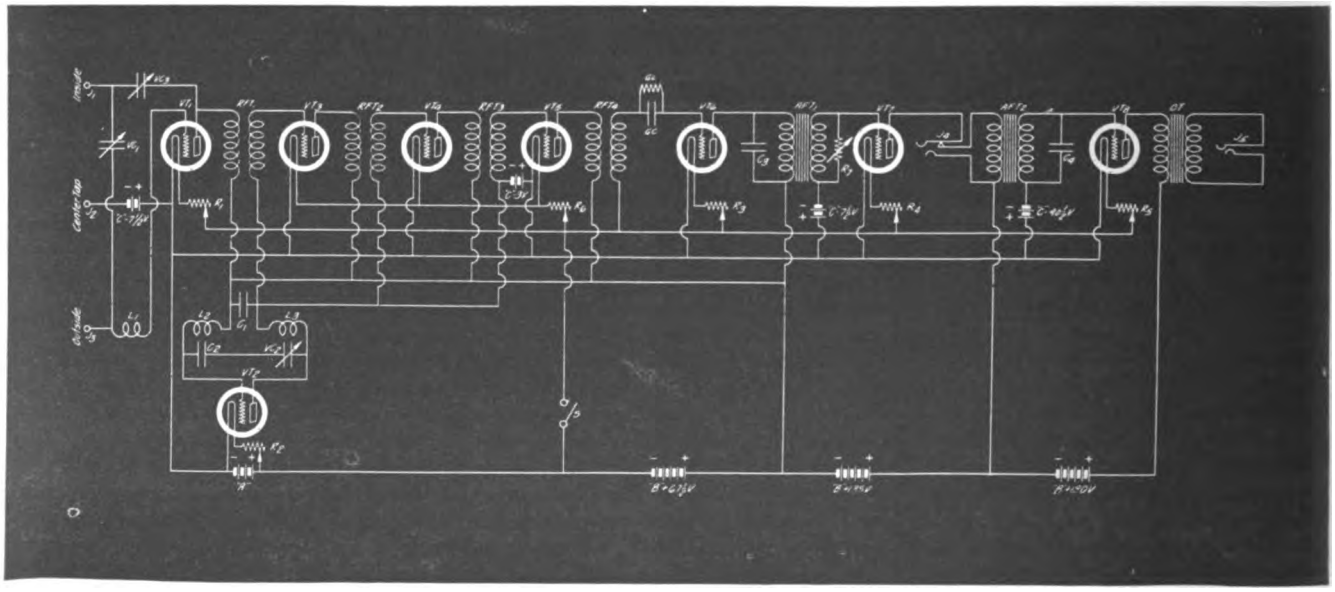
Popular Radio Circuits

INSTALLMENT NO. 10

THE PARTS THAT ARE RECOMMENDED FOR USE IN THIS RECEIVER ARE—

RFT1, RFT2, RFT3 and RFT4—Lincoln long-wave, air-core, high-frequency transformers;
AFT1 and AFT2—S-M low-frequency transformers, type 220;
OT—S-M output transformer, type 221;
VC1 and VC2—Remler 360-degree type variable condensers, .0005 mfd.;
VC3—Chelten midget condenser, No. 850;
VT1, VT2, VT3, VT4, VT5, VT6, VT7 and VT8—Benjamin skeleton sockets No. 9044;
L1, L2 and L3—Lincoln-fixt inductance (oscillator coil);
GL—Tobe condenser, .00025 mfd., with grid-leak mounting.
GC—Durham grid-leak, 2 megohms;
C1—Tobe condenser, .5 mfd.;
C2 and C3—Tobe condenser, .006 mfd.;
C4—Tobe condenser, .00025 mfd.;
J1, J2 and J3—Yaxley jacks, No. 416;
J4—Yaxley double-circuit jack, No. 3C;
J5—Yaxley open-circuit jack, No. 701;
S—Yaxley switch, No. 10;
R1, R2, R3, R4 and R5—Yaxley rheostats, 20 ohms, No. 120K;
R6—Yaxley rheostat, 6 ohms, No. 16K;
R7—Centralab variable resistance, 200,000 ohms;
P—Composition panel, 7 by 24 inches;
SP—Composition sub-panel, 7 by 23 inches;
2 S-M dials, type 801;
1 Yaxley cable connector plug, and battery cable, No. 660;
1 Lincoln loop.

COST OF PARTS: *Not over $103.00.*



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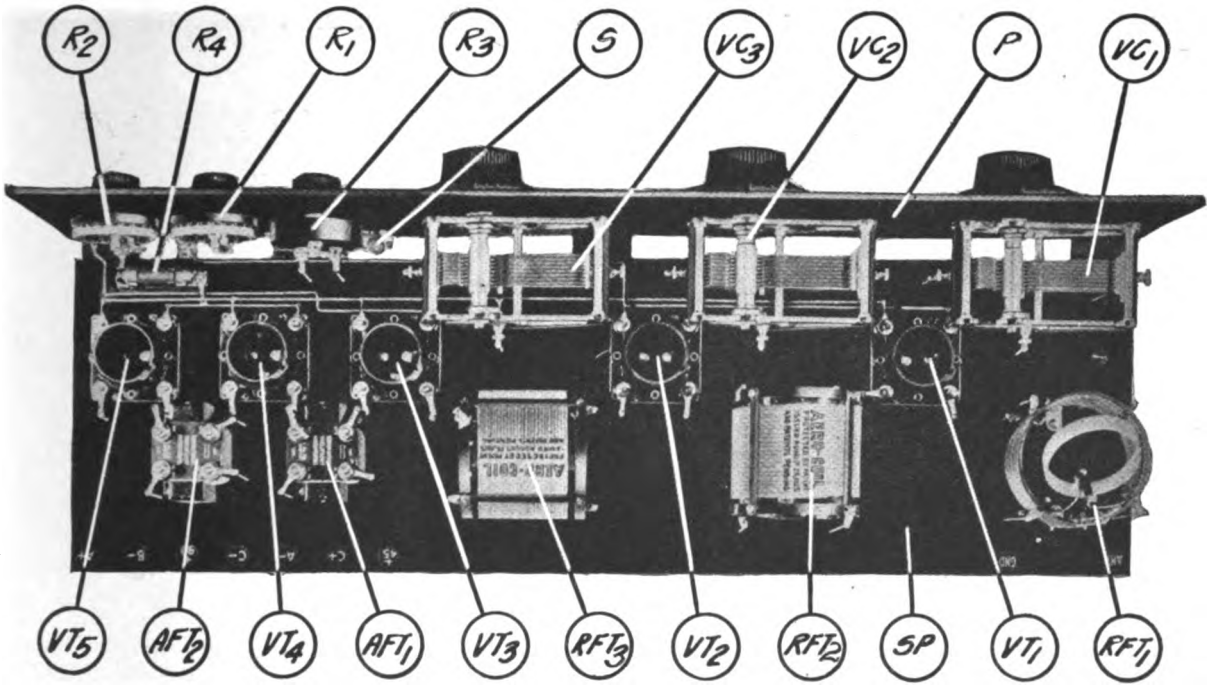


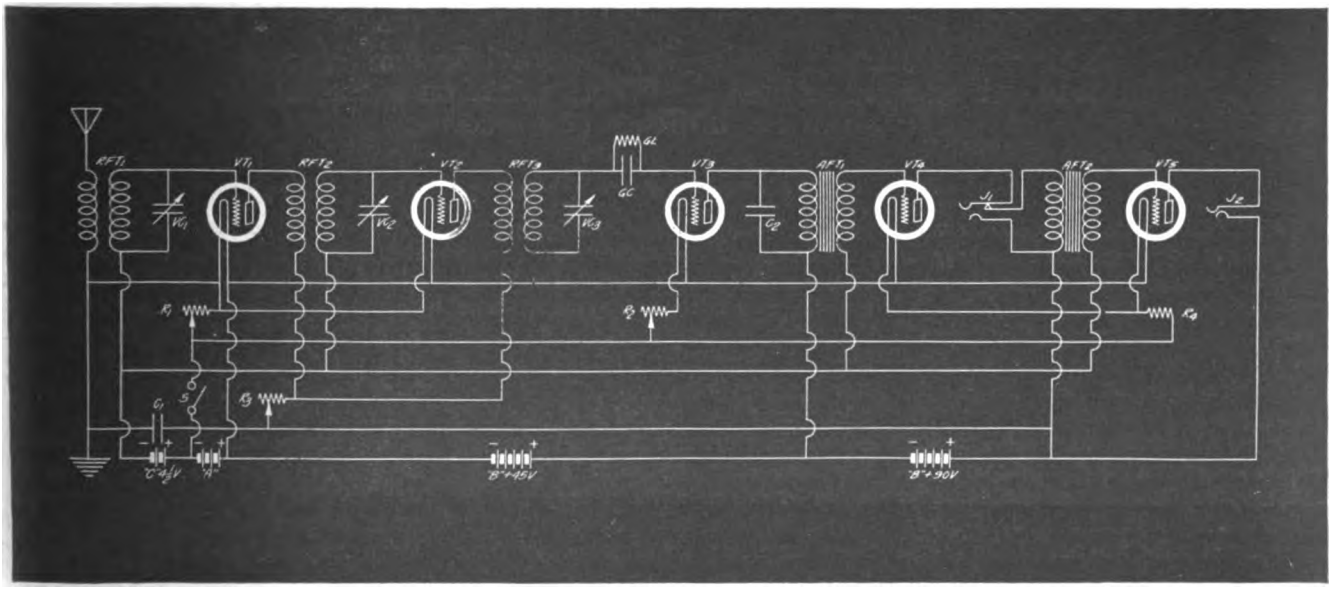
The Aero-Dyne Receiver

This receiver comprises two stages of tuned high-frequency amplification, a tuned vacuum-tube detector stage and a two-stage, transformer-coupled, low-frequency amplifier. The high-frequency amplifier contains efficiently designed coils, and the results obtained with this arrangement should satisfy any set constructor as to selectivity, distance and sensitivity. A variable high resistance in the plate circuit of the first two vacuum valves provides a good means for controlling volume and oscillation. UX-201-a type valves may be used throughout.

The Parts That Are Recommended for Use in This Receiver Are—

RFT1, RFT2 and RFT3—Aero coil set, type TRF-120;
AFT1 and AFT2—Thordarson low-frequency transformers, ratio 3½ to 1;
VC1, VC2 and VC3—Karas Orthometric variable condensers, .00037 mfd.;
VT1, VT2, VT3, VT4 and VT5—Benjamin cushion sockets, No. 8645;
J1—Yaxley two-circuit jack, No. 2A;
J2—Yaxley open-circuit jack, No. 1;
GL—Dubilier grid-leak, 2 megohms;
S—Yaxley battery switch, No. 210 (with pilot light);
R1—Yaxley rheostat, 20 ohms, No. 120K;
R2—Yaxley rheostat, 15 ohms, No. 115K;
R3—Centralab variable resistance, zero to 200,000 ohms;
R4—Amperite, No. 112 or Daven ballast, ½ ampere;
C1—Dubilier fixed condenser, 1 mfd.;
C2—Dubilier mica fixed condenser, .001 mfd.;
GC—Dubilier mica grid condenser, .00025 mfd. (with grid-leak clips);
P—Formica panel, verichromed and drilled, 7 by 28 by 3/16 inches;
SP—Composition sub-panel, 7 by 27 by 3/16 inches;
3 sub-panel brackets;
3 Kurz-Kasch "Aristocrat" port dials, 4-inch diameter, No. 567;
9 Eby binding posts.

Cost of Parts: *Not over $71.00.*



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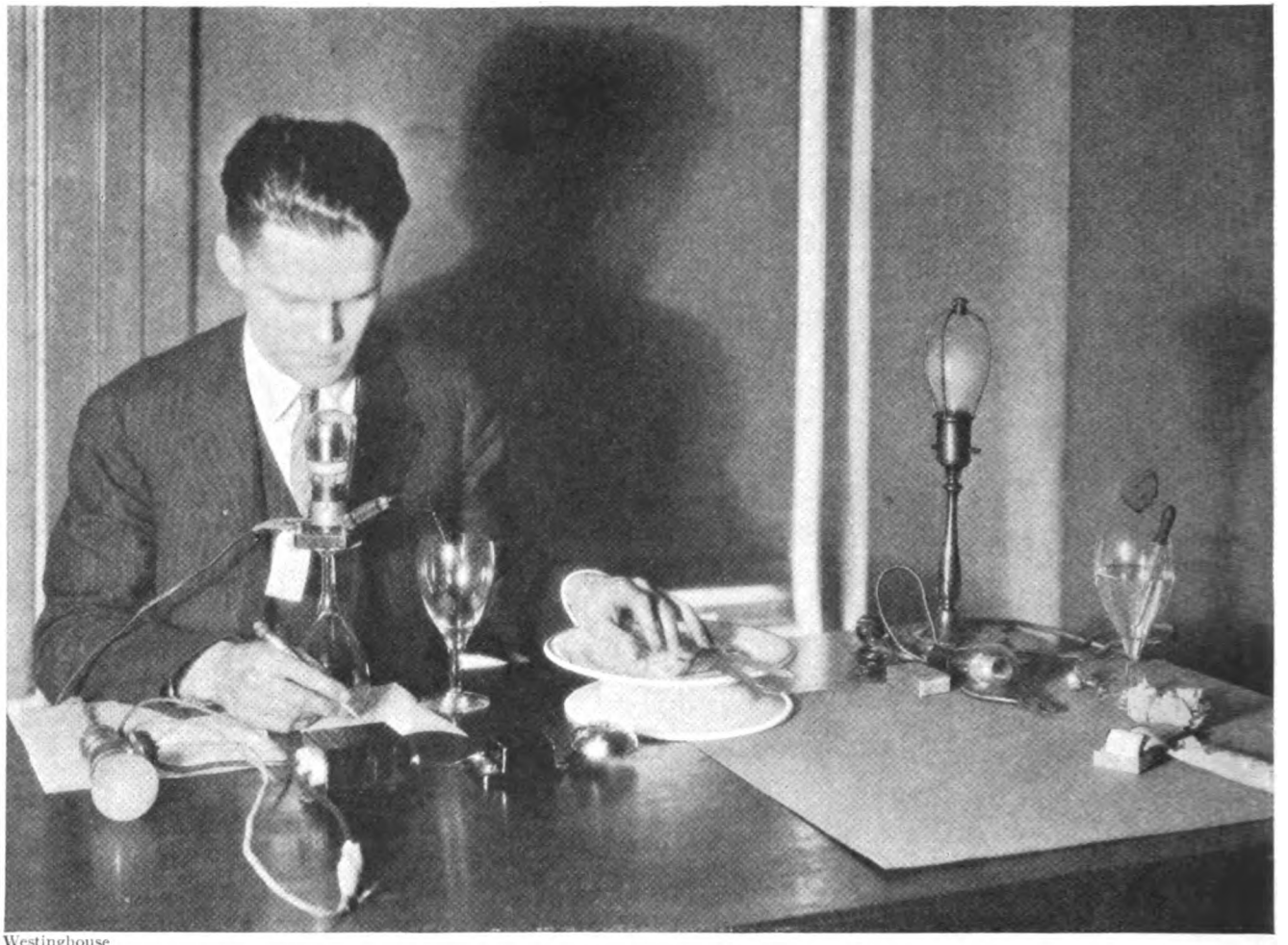

Westinghouse

A DROP OF WATER THAT RINGS A BELL

A drop of water running down the two wires into the glass in the center of the picture will cause the grid-glow relay to operate and will ring a bell. By changing the connections slightly, the action of a burglar in picking up the silver on which Mr. Knowles' hand rests could be made to sound the alarm. The relay itself, looking not unlike a rectifier tube, is on top of the inverted drinking glass just in front of Mr. Knowles.

THE NEW AND REMARKABLE

"40th Fly-Power Relay"

This new electronic device has an amplification of more than one hundred million times, and works on a current of about one billionth of a watt.

By E. E. FREE, Ph.D.

THE familiar electrons of our vacuum tubes are used in a new way in the astonishingly sensitive "grid-glow relay" recently invented by Mr. D. D. Knowles, of the Research Laboratory of the Westinghouse Electric & Manufacturing Company, at East Pittsburgh, Pennsylvania.

So delicate is this remarkable device that the energy necessary to operate it equals, Mr. Knowles calculates, only about one billionth of a watt, which is approximately the amount of energy expended by a fly in walking the distance of one fortieth of an inch up a wall.

Although devised with an eye mainly on its possible uses in electrical engineering, the new relay may prove to have interesting applications in radio, some of which possibilities POPULAR RADIO is now investigating.

The relay is contained in a glass bulb not unlike a vacuum tube and possesses three metallic electrodes: a grid, an anode and a cathode. These are arranged, however, in the reverse direction from the electrodes of a vacuum tube. Figure 2 shows the arrangement of the elements. The cathode, corresponding to the filament, is the outer one and consists of an open aluminum cylinder one inch in diameter and one and one-fourth inches long. Inside this is the anode, which is a nickel wire shielded with a glass tube, except at its very tip. The "grid" is another wire, also glass shielded, and with its upper end bent over the tip of the anode, so that a distance of exactly one thirty-second of an inch separates them. The tube is filled with neon or argon or some other inert gas, under very low pressure.

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In operation, an alternating potential of about 440 volts, at the usual 60 cycles, is impressed between the cathode and the anode. The grid is left "floating"—not connected to anything. As experts in electronic devices will perceive at once, this produces an accumulation of negative charge on the grid, which stops any passage of current between the anode and the cathode.

Suppose, now, that this accumulated charge on the grid is led away by touching the grid wire or in any other way. Current will then pass between the cathode and anode, being self-rectified as it passes. Any electric leakage from the grid circuit serves, therefore, as a very minute signal to start the much larger current through the tube itself. The "amplification" of this action (not quite the same, of course, as the amplification of an ordinary radio tube) reaches the enormous ratio of one to about one hundred million.

If the wire connected to the grid enters a gas flame (see Figure 1), the leakage of electrons into the flame will be sufficient to discharge the grid and to start the tube current. Leakage from the grid into water, such as might be caused by a rainstorm, is equally efficacious. The relay will serve, therefore, as a detector either of fire or of flood. By reversing the connections, it may be used to sound a danger signal if the fire in a stove or furnace goes out. If the grid is connected to a sheet of tinfoil underneath a jeweler's display tray, the capacity effect of a thief's hand stretched out to carry off some apparently unprotected article will cause sufficient leakage to start the relay and give the alarm. In an especially ingenious application worked out by Mr. Knowles, the capacity of the body of someone who stops in front of a store window is made to start the window lights or to operate electric circuits displaying a series of signs inside the window, starting a revolving display machine, or otherwise amusing the inlooker, all quite automatically.

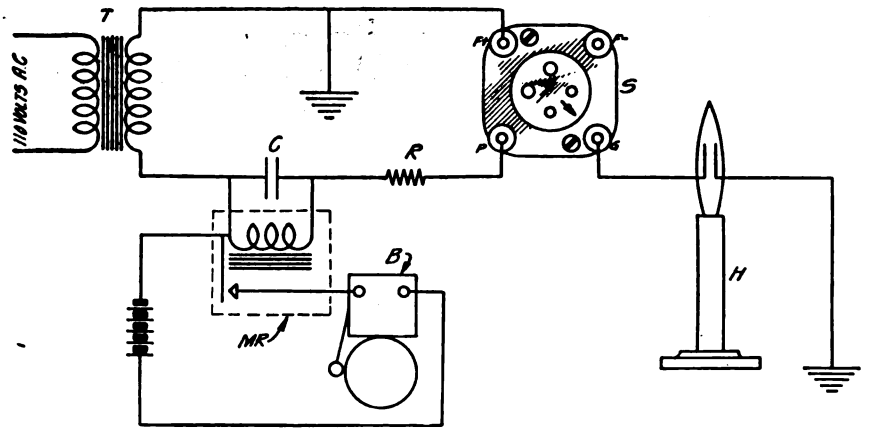

FIGURE 1: *This hook-up shows the connections of the grid-glow relay when acting as a detector of flame. The transformer produces 440 volts alternating current between the anode and cathode of the relay. The grid of the relay is connected with a wire projecting into the flame. Ions in the flame permit the charge to leak off this grid to the ground wire and allow the relay tube to operate. If the flame goes out, the leakage ceases and the tube current stops. The relay circuit may be arranged to ring the signal bell either if the flame starts or if it goes out.*

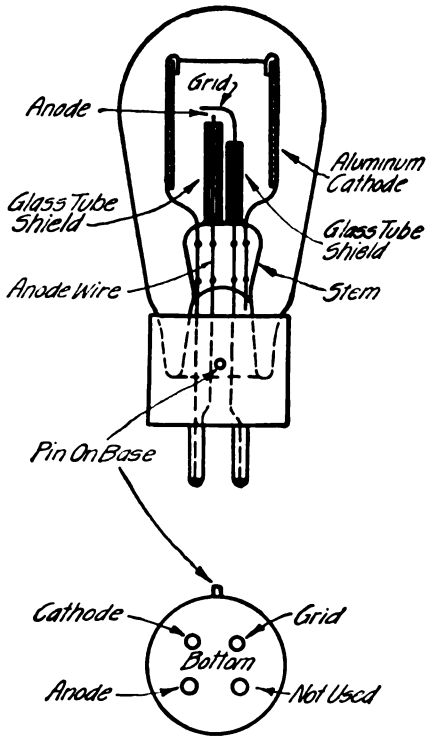

FIGURE 2: *The aluminum cylinder which forms the cathode is connected to one terminal of a standard radio-tube base and the anode wire to another. The grid wire comes out to the grid terminal of the base, the fourth terminal remaining unconnected.*

It Happens in the Best of Sets

A Monologue That Every Fan Will Recognize

"OH, hello, Smith! Come in, you're just in time; we were getting WAOW just a while ago—that's Omaha, you know. I'll get some good station for you in a jiffy—this radio certainly is a jim-dandy—best ever.

"I think I hear someone now. . . . Let's see, that ought to be KHJ. . . . I'll have him in just a minute; sometimes, you know, it's a trifle hard getting tuned in. There's so many on the air—it's hard tuning them all out. . . . Um, guess they're not on to-night. . . . Well, I'll try someone else. Let's see, now, what's doing at . . . Oh, mother, is WLZB on the air to-night?

"I think it is; let's see, what is their wavelength? . . . You know, Bob, I've sure been having a wonderful time with this radio—yes, indeed—best in the country; wonderful range, volume, all that sort of thing. And so simple, too; easy to handle. . . . Ah, here's someone. . . . No, I guess not; thought I heard someone then. . . .

"That's funny; don't seem to be anyone on the air to-night. . . . What time is it? The air ought to be full of 'em. Wonder if London's trying to get through to-night? . . . H'm, let's look at these tubes; well, they seem to be all right. . . . The aerial seems to be in the correct position. . . . That *is* funny. H'm.

"What? Going already? Why, Bob, I haven't had anyone yet; you *must* hear someone. . . . I'll have them in just a minute. Why, you've just come over—and you came to hear it. Well, if you *must*, I suppose you must, but do drop in again, Bob, by all means. . . . Good night!

"H'm now let's see . . . what is wrong with this confounded thing, anyway? . . . Whoa! Gee whiz, I forgot to turn on the switch. . . . Oh, Bob; say, *Bob*—HEY!"

—FRANK ROMANO.

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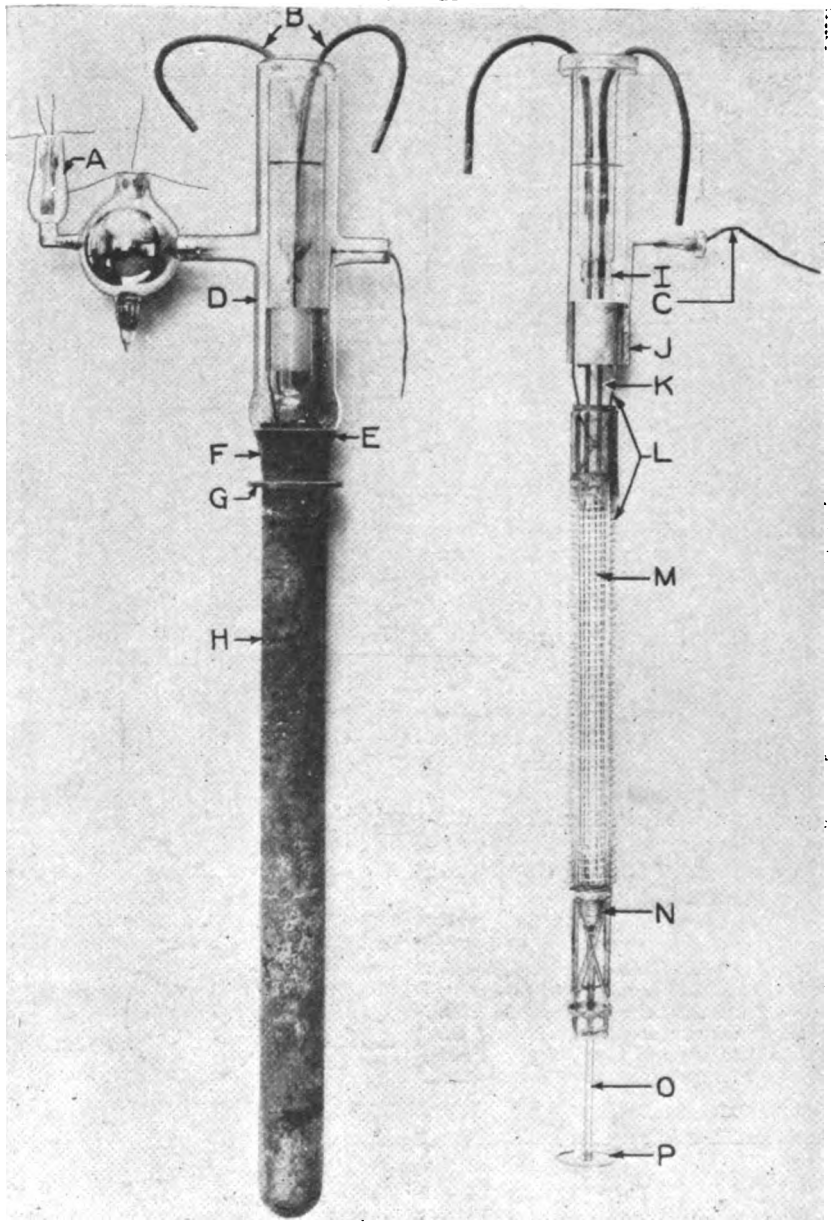
The Biggest Radio Vacuum



General Electric

TWO VIEWS OF THE 100-KILOWATT VALVE

At the left is an outer view of the valve; the picture at the right shows the elements inside of the tube. A is the ionization gauge; B, the filament leads; C, grid lead; D, the high-tension bushing; E, the glass junction to the copper anode; F, the anode seal; G, the securing flange; H, the anode proper; I, the filament pinch seal; J, the grid clamp; K, the inner filament leads; L, the tungsten grid; M, the filament wires; N, the filament support; O, the quartz support, and P, the spacer disk.

AND now comes the colossal 100 kilowatt tube (or "valve," as it is properly called)—the greatest of the gigantic valves to bear the designation of "the grandfather of all valves."

Picture a valve that stands nearly two feet higher than the average man; that weighs a hundred pounds, and that is 400,000 times as powerful as the ordinary valve in a radio receiver, and you will get an approximate idea of this newest product of the radio laboratory.

For the past few weeks the high-powered transmitter of WGY, at Schenectady, N. Y., has been using this transmitting vacuum valve, thus marking the first practical use of a valve of this size by any broadcasting station. It takes the place of eight 20 kilowatt valves in WGY's transmitter.

With such a transmitting valve available, engineers of the General Electric Company will be able to carry on their investigations in broadcasting on higher powers than have ever before been possible.

Up to the present time 50 kilowatts in the antenna has been known as "superpower," but with valves of an output of 100 kilowatts at hand, investigations will be possible up to 500 kilowatts or more. The 100 kilowatt vacuum valve is used as a high-frequency amplifier, fulfilling in the transmitter a use comparable with the high-frequency stages in most receivers. In the receiver a very weak, high-frequency oscillation is picked up by the antenna. This excites the high-frequency amplifier valve which amplifies the power or signal. In the transmitter, the output of one 20 kilowatt valve is amplified by the 100 kilowatt valve.

In the development of the 100 kilowatt valve the research laboratory had to devise an entirely new structural design to provide necessary strength and durability. Outside of its water jacket the new valve stands five feet high and two thirds of this height consists of the copper envelope, which is four inches in diameter. The envelope serves a double purpose, for it not only contains the elements of the tube but is itself the anode or plate.

The upper portion of the valve is made of glass through which protrude the insulated filament leads and the grid lead. The glass bulb is twenty-two inches long and four inches in diameter and it is sealed to the spun out end of the copper anode cylinder in such a way that the junction of glass and copper is mechanically strong and vacuum tight.

Two copper cables of a size capable of carrying a current of several hundred amperes act as leads and are connected to tungsten rods which in turn pass through a "pinch" seal terminating as inner filament leads at the filament ends. Three lengths of tungsten wire, each about 16 inches long, connect to each of the inner leads, forming six parallel filament spans. These pass within the grid and meet at a common point at the filament spring suspension in the lower end of the valve.

The grid, within the copper envelope, is cylindrical and has an overall length of three feet, five inches. The grid frame is a most ingenious structure of molybdenum and tungsten. Bracing, such as is commonly used in steel bridge and tower construction, provides maximum strength with a minimum of

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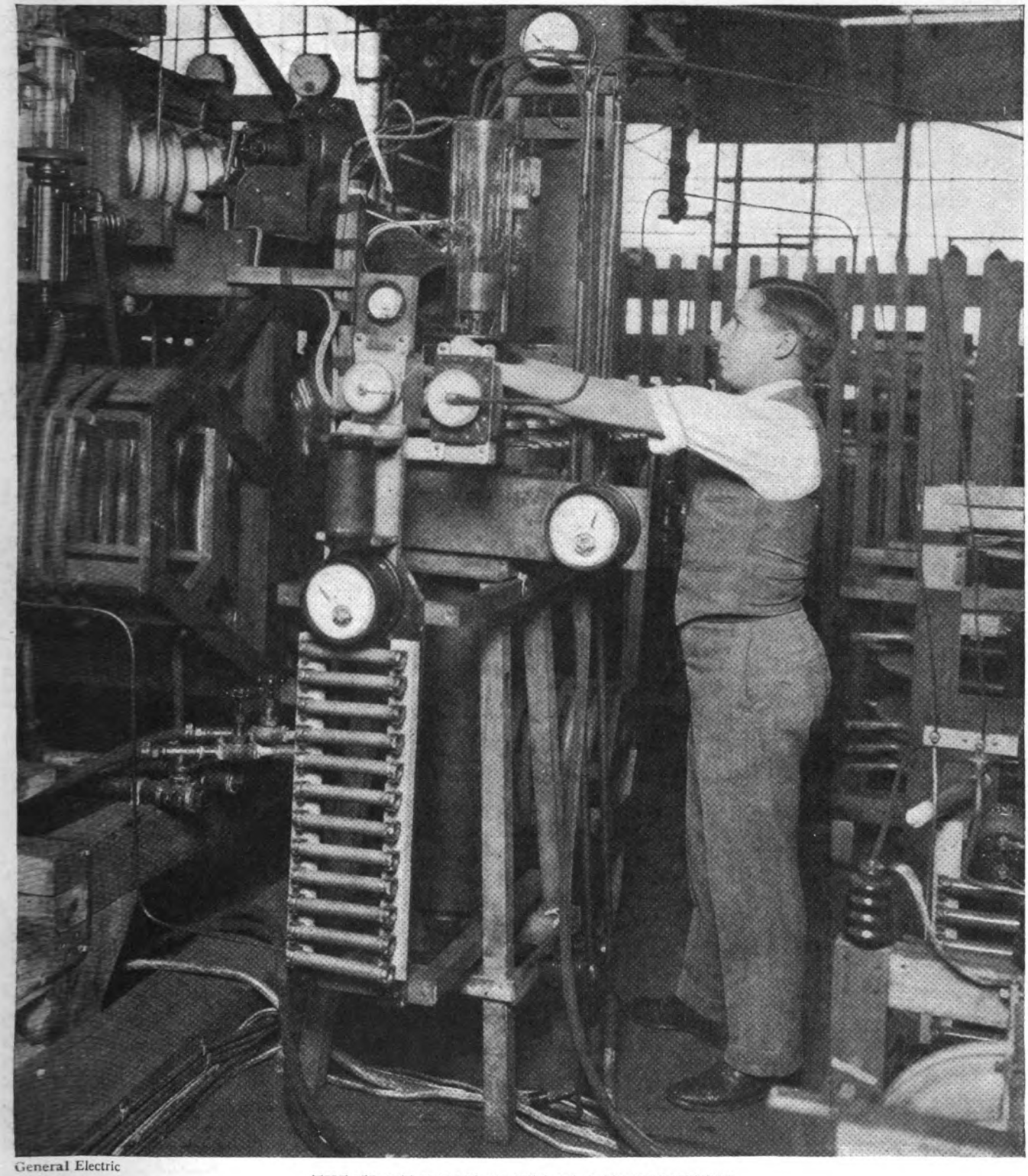
Valve in the World

By
W. T. MEENAM



General Electric

THE GIANT VALVE IN USE AS A TRANSMITTER

In the center of the picture may be seen the new monster valve, with part of the accompanying apparatus for its control. It generates high-frequency oscillations of the most powerful order of any that have ever been propagated by a single tube.

metal. Sufficient rigidity and strength are necessary in this construction to prevent short circuiting from sagging.

To guard against failure due to large pressure increases in the valve, a pressure gauge or, more properly, an ionization gauge is used on the 100 kilowatt valve. This gauge takes the form of a special three-element vacuum valve.

This gauge operates on the principle of the ratio of ionization by collision with electrons to the amount of gas present.

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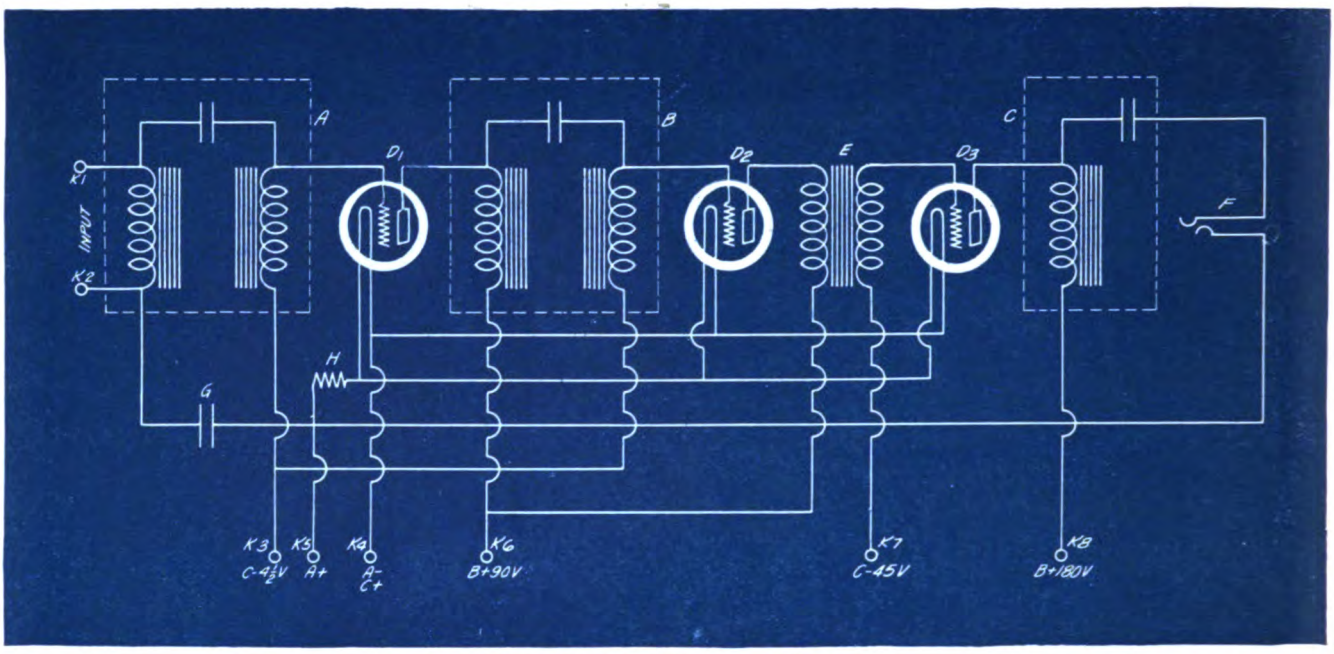
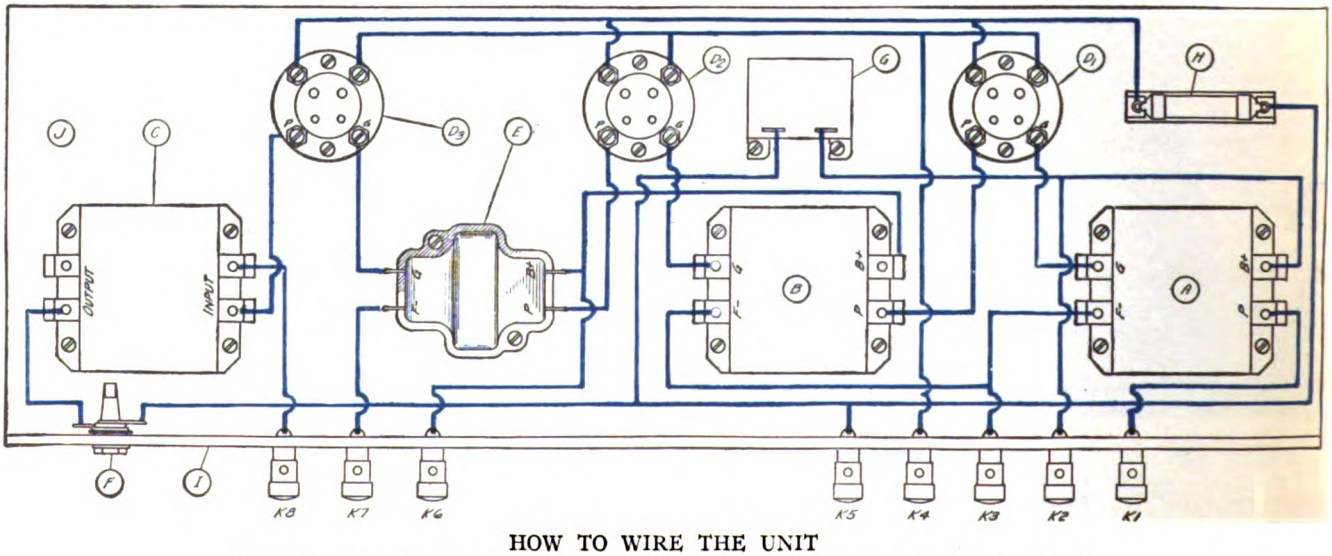


THE SCHEMATIC WIRING DIAGRAM

FIGURE 1: *In the electrical circuit employed in this amplifier unit the first two stages of amplification contain two separate units that include two low-frequency chokes and a coupling condenser; the third stage is a regular transformer-coupled stage with a low-ratio transformer. The output contains a filter unit consisting of a choke and a suitable high-voltage condenser. To keep the direct current from the windings of the reproducer, two regular tubes are used in the first and second stages, with a power tube in the last stage.*

¶ *The list of parts given on page 541 includes the exact instruments used in the laboratory model of this receiver. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*



HOW TO WIRE THE UNIT

FIGURE 2: *This diagram gives the general layout of the instruments in this unit, with the exact electrical connections to be made. The instruments are outlined in* BLACK; *the* BLUE *lines indicate the wiring. As there are no critical positions for the instruments, exact spacing on the baseboard is not necessary. If this diagram is followed by the constructor, there will be no trouble in getting the unit to function properly.*

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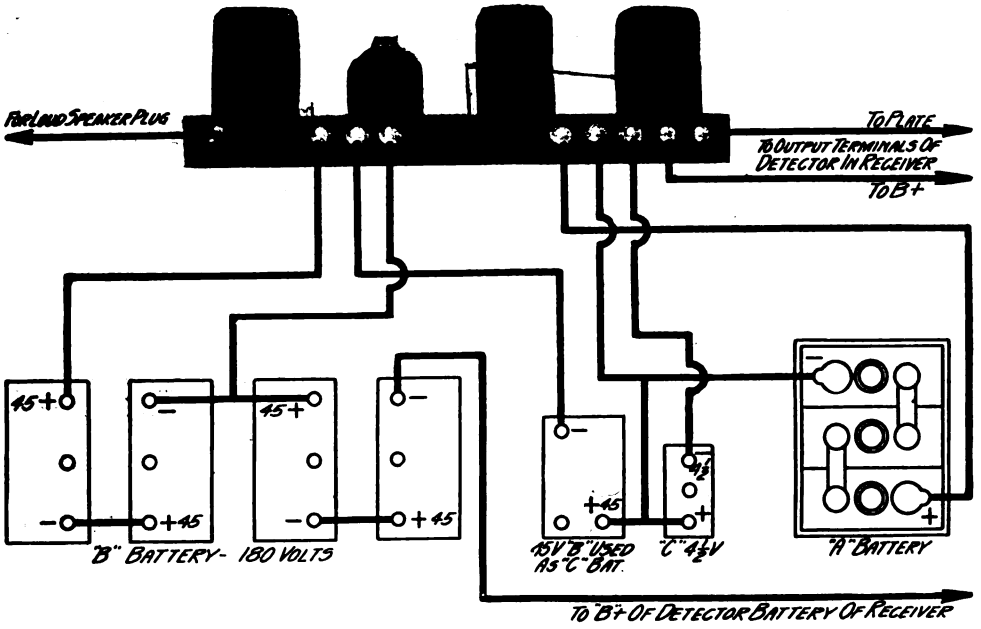

HOW TO HOOK UP THE NEW AMPLIFIER

FIGURE 3: *This diagram shows how the amplifier is put into action. In the lower part are the connections with the "A," "B" and "C" batteries. The leads to the reproducer and to the detector circuit are shown in the upper corners.*

How to Get Quality Amplification

NUMBER 3: *Here are the constructional details for building a low-frequency amplifier that you can use just as successfully with your old receiving set to better the quality of amplification as with your new receiver. It employs two stages of double impedance coupling and one stage of transformer coupling with an output filter.*

By THE TECHNICAL STAFF

COST OF PARTS: *Not more than $32.00*

HERE ARE THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS UNIT—

A and B—General Radio double-impedance couplers, type No. 373;
C—General Radio speaker filter, type No. 387-A;
D1, D2 and D3—General Radio sockets, type No. 349;
E—General Radio low-frequency transformer, type No. 285, ratio 1-2.7;
F—Carter short jack, No. 1;
G—Tobe paper output-filter condenser, 2 mfds.;
H—Elkay equalizer, type 1, for use with four UX-201-a type valves equipped with mounting;
I—Bakelite binding-post strip, 1½ by 16 by 3/16-inch;
J—Wooden baseboard, 6 by 16 by ½-inch;
K1, K2, K3, K4, K5, K6, K7 and K8—X-L push posts, lettered as follows: Two marked, "C" battery minus (—), "A" minus (—), "A" battery positive (+), "B" 90 positive (+), "C" battery minus (—), Amp. "B" positive (+), respectively.

THIS new amplifier is especially designed to bring out the low tones of speech and music with exceptional volume; at the same time it preserves an equal amplification over the middle range of audible frequencies as well as the upper range.

The amplifier pack consists of two stages of double impedance-coupled amplification followed by one stage of low-ratio transformer-coupled amplification equipped with an output filter consisting of a suitable choke and high-voltage condenser unit.

This amplifier may be incorporated in place of the old-fashioned amplification scheme in any old receiver to bring the quality of reproduction up to date, or it may be used with a new model that the experimenter is building in his home.

The model described was designed especially for this purpose by the staff of POPULAR RADIO EXPERIMENTAL LABORATORY, and it has been fully tested out and its outstanding features noted.

The schematic wiring diagram of the circuit used in the amplifier pack to be described is shown in Figure 1.

How to Construct the Unit

To build the amplifier pack, cut the baseboard, J, to the proper size, 6 by 16 by ½-inch. Then prepare the binding-post strip, I, as shown in Figures 2 and 4. The dimensions for the binding-post strip are 1½ by 16 by 3/16-inch.

The eight binding posts, K1, K2, K3, K4, K5, K6, K7 and K8 and the jack, F, are then fastened to this strip in the order shown in Figure 2.

Now the various instruments, including the couplers and the transformers, the sockets, filament resistor and the out-

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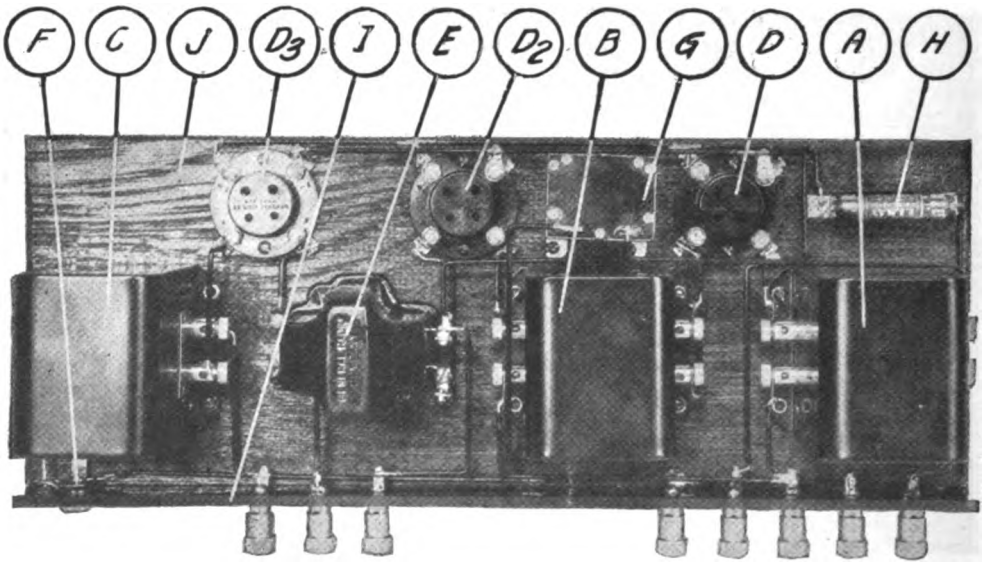


A VIEW OF THE AMPLIFIER FROM ABOVE

FIGURE 4: *In this illustration the arrangement of the apparatus mounted on the baseboard is clearly shown. The eight binding posts are mounted on a connection block that runs the whole length of the baseboard.*

put filter, may be mounted on the baseboard, J. Next attach the binding-post strip, I, to the baseboard by means of three strong wood screws inserted through the strip and into the edge of the baseboard.

The wiring should be done exactly as shown in Figure 2; this carries out the wiring scheme given in the schematic drawing in Figure 1.

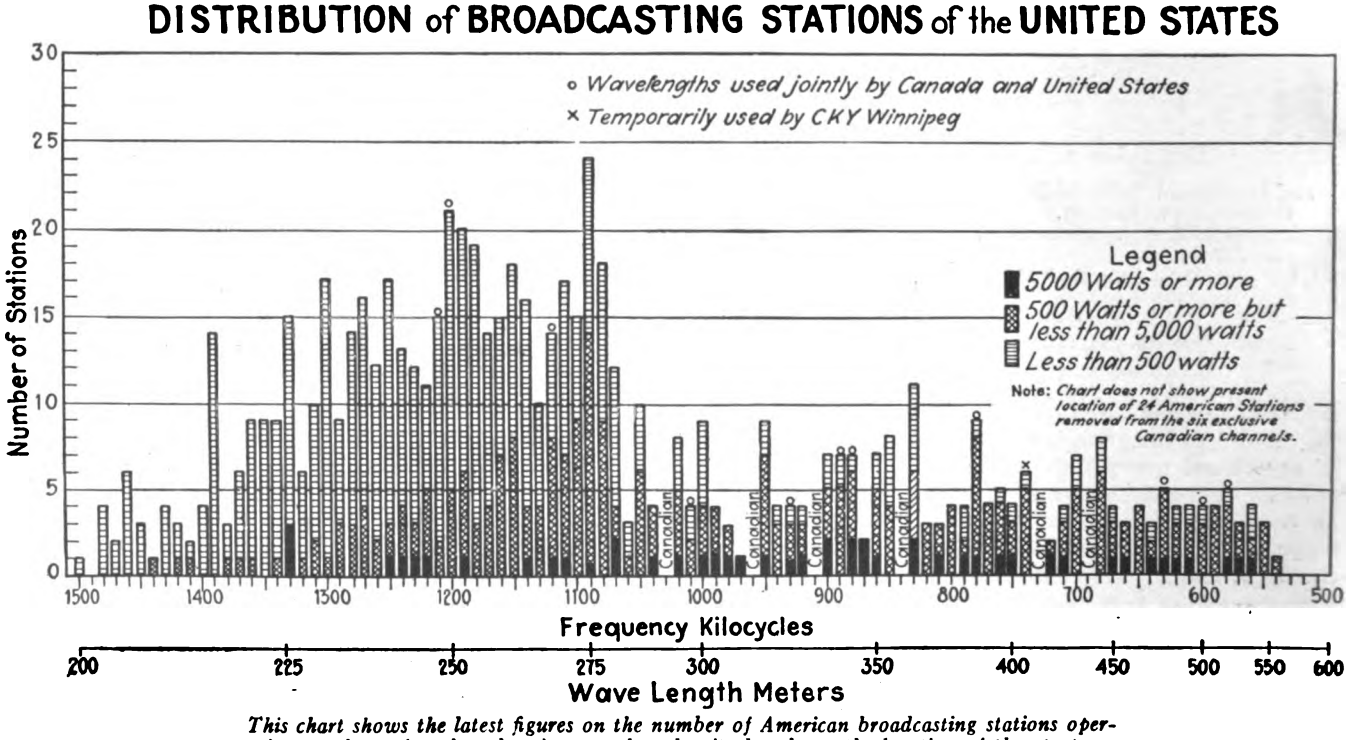
When the wiring is completed, the unit is ready to be installed.

In Figure 3 is shown the method for connecting the unit to the batteries and to the detector circuit of the set with which the amplifier pack is to be used.

Insert two UX-201-a type valves in sockets D1 and D2, and insert a UX-171 type valve in the socket D3, which is the power stage.

When the vacuum valves have been placed in their respective sockets, the amplifier pack is ready for use. It should be used with a high quality reproducer that is capable of reproducing all the tones, both high and low, that the amplifier furnishes. The reproducer is plugged into the amplifier pack by means of a phone plug inserted into the jack, F.

The receiver with which this unit is used may be tuned in the usual manner and the quality of reproduction will be found to be almost astonishing in its clarity and great volume.



This chart shows the latest figures on the number of American broadcasting stations operating on the various broadcasting wavelengths; it also shows the location of the spectrum of the eighteen channels that are now being used by Canadian stations (six of which are exclusive and twelve of which are shared with American stations).

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From a photograph made for POPULAR RADIO

A RADIO RECEIVER THAT YOU TURN ON LIKE THE HEADLIGHTS OF YOUR CAR

FIGURE 1: *The tuning controls are an integral part of the dash-board, and are within easy reach of the driver. The reproducer may be seen at the top of the windshield.*

Just a Dash-Board of Reception

Here is an ingenious and highly compact radio installation that provides for a receiver hidden behind the control board of your motor car, an antenna concealed in the top, batteries installed behind the seat—and a miniature loudspeaker set up over the mirror.

By LAURENCE M. COCKADAY

IF C. A. Duryea, the inventor and driver of the first "horseless carriage," had known of radio back in 1892, he probably would have started experimenting then with the installation of a receiving set in his historic motor car.

Ever since radio broadcasting's earliest days the idea of radio as an accessory to the automobile has persisted, and although there have been many more or less successful attempts to reach a practical solution (such as the use of portable sets, sets installed on the running board, sets installed in a carrier trunk at the rear of the car and numerous other makeshifts), only recently has a practical installation been developed for the radio fan who is also a motorist.

This new type of installation, which has been developed especially for motor work, is the outcome of long experiment and research by William Heina, the designer. He has finally developed a receiver sensitive enough to work inside the steel body of any type of automobile.

This novel installation consists of three stages of high-frequency amplification with three tuned circuits, and operates by two dials. Two stages of low-frequency amplification produce enough volume to operate the loudspeaker. The set is contained in a heavy steel cabinet of small dimensions and is installed back of the dashboard with the two controls easily within the driver's reach, as shown in Figure 1.

The receiver in no way interferes with either the room in the car or the controlling mechanism, from a driver's standpoint.

The dashboard that carries the radio set is made up in standard designs for va-

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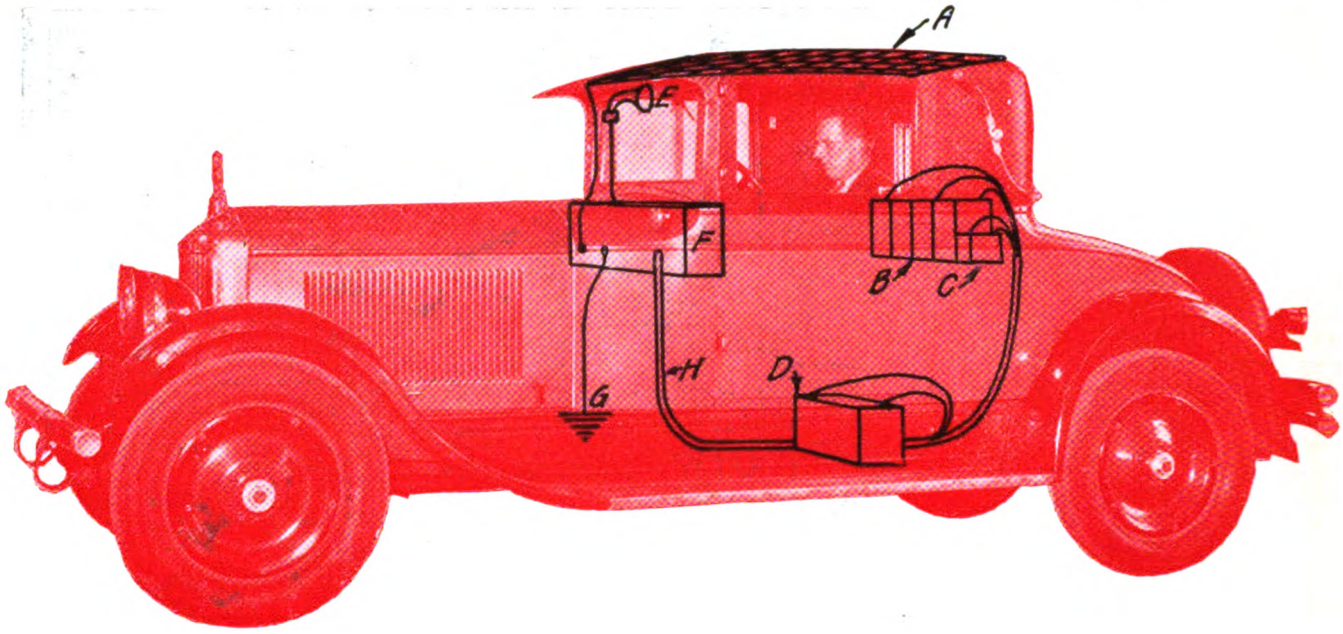

HOW THE NEW SYSTEM IS INSTALLED

FIGURE 2: *The antenna, A, consists of a copper mesh erected between the outer and inner upholstery of the top of the car. The "B" and "C" batteries are installed in any convenient compartment, in this case in the back of the seat. The "A" battery, D, is the automobile storage battery used in starting and lighting; E is the loudspeaker; F, the set proper; G, the grounding, which is made on the chassis; and H is the armored cable that connects the battery to the set.*

From a photograph made for POPULAR RADIO

INSTALLING THE "B" BATTERY

FIGURE 3: *This picture shows how the "B" batteries may be fastened snugly in place underneath the front seat of a five-passenger touring car. Three standard sized "B" batteries are used.*

From a photograph made for POPULAR RADIO

ELIMINATING INTERFERENCE BY SHIELDING

FIGURE 4: *The man in the picture is pointing at the copper shielding on the ignition coil. Notice also the copper shielding covering the wires leading to the coil.*

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rious types of cars, and the whole set, including the aerial, loudspeaker and "B" batteries, may be installed within two or three days' time. The appearance of the car remains exactly the same as before, with no exposed wires or accessories other than the small loudspeaker that is shown above the mirror in Figure 1.

In preparing an installation of this type, a small capacity antenna, consisting of a strip of copper mesh, is installed in between the outer and inner coverings of the top and the lead-in wire is brought down through the sides of the body where it will be out of the way and invisible.

In Figure 5 is shown an antenna installation in process of construction. The inner upholstery has been loosened and the copper mesh is being applied, after which the inner upholstery will be put back. The antenna thereafter will be an integral part of the car, but it will be out of sight and out of the way. An antenna of this type is non-directional and reception will be equally good with the car pointed in any direction. This is an advantage over the loop type of antenna for a car.

The "B" batteries used in the receiver are installed either in one of the seat compartments or in the luggage carrier or package compartment. They are fastened securely so that they cannot bounce around or rattle and are connected to a special battery cable manufactured for the purpose and covered with a metal sheath.

The car battery is used for the "A" battery. A typical battery installation is shown in Figure 3.

In actual demonstrations the author has found the receiver to be entirely satisfactory for reception up to 100 miles either during the day or at night, and on a number of occasions distances up to 1,000 miles have been received in the evening. In Figure 2 is shown a diagrammatic assembly of the receiver installed in the author's car.

From a photograph made for POPULAR RADIO

HOW THE ANTENNA IS HIDDEN IN THE TOP

FIGURE 5: *The copper wire screen used for the capacity pick-up is attached in between the outer and inner upholstery of the roof, so that when once installed it is out of the way, as well as out of sight; no visible wires are left hanging.*

One of the hardest problems to eliminate, in an installation of this type, is the electrical motor noise caused by the ignition and accompanying wiring.

In Figure 4 is shown a method for cutting down such interference. It consists of a shielded compartment for the coil and shielded wires running to the distributor head and to the spark plugs. This shielding, of course, must be grounded to the frame of the car, which is also used as a ground for the receiver.

During the summer vacation hours this type of receiver will be an especial boon to the motorist, as it may be used to keep him in touch with the world when he is off on a pleasure trip. The car may be parked anywhere and programs received from city stations with ease.

For a vacationist at his country home a loudspeaker extension cord may be run from the garage into the cottage and a loudspeaker installed right in the living room. It may be tuned to the best station and will serve for dance music or other forms of broadcast entertainment.

A Remarkable Music-Making Appliance

In the July issue of POPULAR RADIO will appear an article that will be of immense interest to music lovers, to owners of radio receivers and of phonographs alike. The article will tell how to convert any phonograph into an electrically operated music-making device of the highest order. The article will give all of the details of the changes that are necessary to obtain reproduction from the phonograph that in both quality and volume is every bit as good as the finest radio reproduction—because radio principles are used in it.

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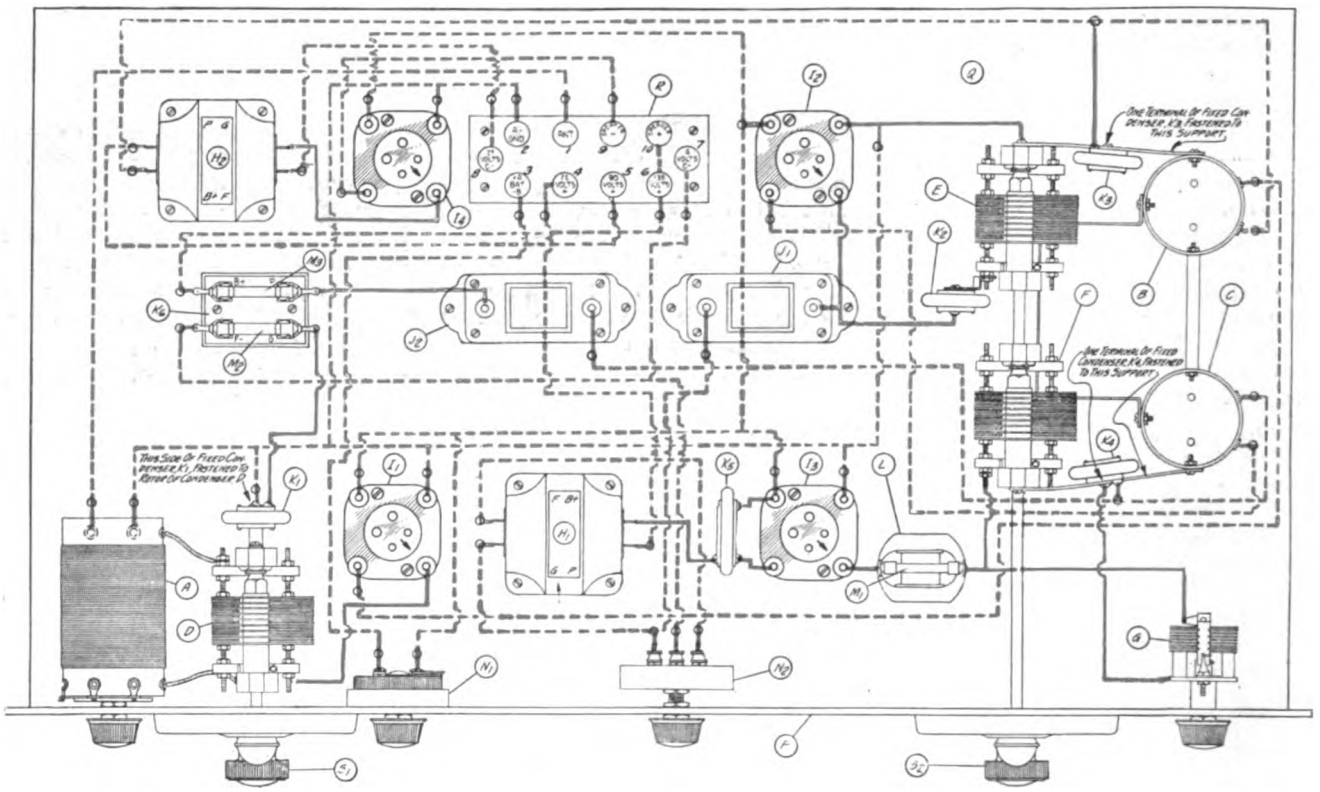

THE PICTURE WIRING DIAGRAM

FIGURE 1: *In this drawing all the parts that are mounted on the panel and on the baseboard are drawn in* BLACK *lines. All of the wiring that is in view on top of the panel is shown in heavy* RED *lines and the wiring beneath the panel is indicated in dotted* RED *lines. The* BLACK *circles show where the wires go through the panel.*

HOW TO ASSEMBLE

The RGS RECEIVER

This is the second of a series of articles on the assembly and operation of popular kits of parts that may be obtained for building really good radio receivers. The series differs from the "How-to-build" articles, in that the sets described have been designed outside of the POPULAR RADIO Experimental Laboratory, by commercial engineers. The sets that are selected for description, however, have been carefully tested in the POPULAR RADIO Laboratory and will be chosen for their outstanding features and all-around efficiency.

By JOSEPH CALCATERRA

COST OF PARTS—*Not more than $70.00*

HERE IS THE LIST OF PARTS NECESSARY FOR THE CONSTRUCTION OF THE RECEIVER—

A, B and C—National RGS coils;
D, E and F—National RGS variable condensers;
G—Hammarlund midget variable condenser;
H1—Samson low-frequency transformer, 2 to 1 ratio, type HW-A3;
H2—Samson low-frequency transformer, 6 to 1 ratio, type HW-A3;
I1, I2, I3 and I4—Benjamin sockets, No. 9040;
J1—Grimes grid choke;
J2—Grimes filter choke;
K1 and K2—Sangamo fixed condensers, .00025 mfd.;
K3, K4 and K5—Sangamo fixed condensers, .001 mfd.;
K6—De Jur resistance mounting, complete with coupling condenser;
L—Sangamo fixed condenser, .00025 mfd., with grid-leak mounting clips;
M1—Lynch metallized grid-leak, 2 megohms;
M2—Lynch metallized resistor, 1 megohm;
M3—Lynch metallized resistor, .025 megohm;
N1—De Jur rheostat, 2 ohms;
N2—Centralab variable modulator, 250,000 ohms;
P—Westinghouse-Micarta RGS panel;
Q—Wooden baseboard, 9 by 20 by ½ inch;
S1 and S2—National Velvet Vernier dials, type "B";
10 Eby binding posts and composition connection block strip;
25 feet Acme flexible Celatsite wire.

THE RGS receiver is the outcome of one man's confidence in the fundamental soundness of the "inverse-duplex" principle of amplification.

Long after others had discarded the idea of reflex amplification, David Grimes continued to experiment with his own pet circuit, popularly known as the "IDS circuit."

The new RGS circuit is the result of thousands of actual laboratory experiments made by Mr. Grimes and his assistants over a period of three years.

When he started on his experimentation, Mr. Grimes made the following list of desirable characteristics that a receiving circuit should have before it could win his approval:

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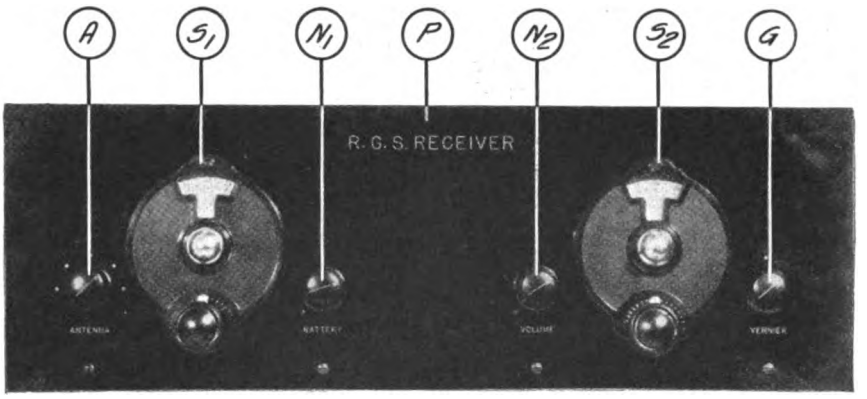
1. Adequate selectivity;
2. Good tone quality, without loss of volume;
3. Equal selectivity over the whole wavelength range;
4. Equal amplification over the whole wavelength range;
5. Straightline volume control;
6. Sensitivity;
7. Adaptability to all antenna sizes;
8. Adaptability to all localities;
9. Ease of construction and operation.

The experiments which followed were conducted with the object of finding ways and means of incorporating these features in the new receiver.

The circuit finally developed to meet these requirements is shown in Figure 3.

Sharp selectivity over the whole wavelength range was obtained through the use of tuned high-frequency circuits and by the application of a new principle discovered by accident during the course of the experiments. It was found that the use of a resistance-coupled low-frequency stage of amplification, using the resistance coupler, K6, introduced what seemed to be at first a very undesirable factor. The coupling condenser of the resistance coupler provided a high-frequency feedback between the plate circuit of the second high-frequency valve and the grid circuit of the first high-frequency valve. This feedback could be made either to aid or oppose, depending on the polarity of the primary winding of the third high-frequency transformer, C. If it was aiding, the feedback produced oscillations which made the circuit unstable; while it it was made to oppose, the loss sustained reduced the efficiency of the circuit. In an effort to eliminate the effect, a filter choke coil, J2, was introduced as shown in Figure 3. This seemed to help materially in preventing instability or loss of efficiency.



A FRONT VIEW OF THE RGS

FIGURE 2: *The various controls on the panel of the new receiver are marked with letters that correspond with the list of parts given at the beginning of this article and with the data in the text.*

While experimenting to determine the smallest choke coil that could be used to advantage, so as to save unnecessary construction expense, Mr. Grimes discovered to his surprise that with a certain value of inductance and resistance for this choke and the coils of the high-frequency transformers connected for aiding feedback, practically no reinforcement was obtained at the low wavelengths around 200 meters, but that the reinforcement increased as the receiver was tuned to the higher wavelength settings up to around 550 meters.

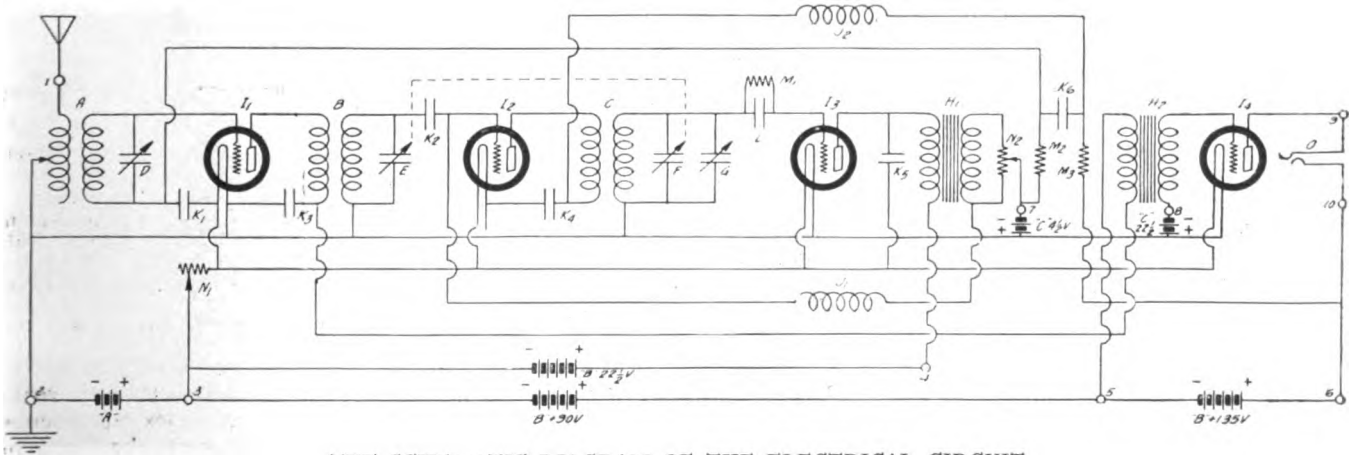
The result was an automatic means of increasing amplification as the wavelength was increased without instability at the short waves. By a curious coincidence, it was found that this not only gave equal amplification over the whole wavelength range, but also provided equal selectivity over the wavelength range—a condition not obtainable by the usual methods that have been adopted to get equal amplification for all wavelengths.

In operation, the signal energy is amplified at high frequencies in turn by vacuum valves, I1 and I2; after this, rectification or detection takes place in the detector valve. The low-frequency energy is transferred, by means of the low-frequency transformer, H1, into the grid circuit of vacuum tube I2 for the first stage of low-frequency amplification. The schematic diagram of the electrical arrangement may be seen at Figure 3.

It is then transferred by means of the resistance coupler, K6, into the grid circuit of valve I1 for the second stage of low-frequency amplification. Finally it is passed through the transformer, H2, to valve I4, which serves as the last low-frequency amplifier.

We have, therefore, the equivalent of two stages of high-frequency amplification, a vacuum valve detector and three stages of low-frequency amplification, using four vacuum tubes instead of six.

The use of a resistance-coupled low-frequency stage, sandwiched in between the two transformer-coupled stages, pro-



THE SCHEMATIC DIAGRAM OF THE ELECTRICAL CIRCUIT

FIGURE 3: *In the theoretical wiring of the RGS receiver, notice the peculiar connection of the choke coil, J2, shown at top of diagram, which is so designed that it makes the amplification obtained uniform over the whole band of frequencies covered by the receiver.*

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duces excellent tone quality. The howling due to resonance and feedback effects, usually encountered when a number of transformer stages are cascaded, is eliminated by the resistance stage.

A 250,000-ohm potentiometer across the secondary of the first low-frequency transformer gives an even variation of volume from minimum to maximum and also provides very good quality by preventing overloading of the audio tubes by strong local signals.

The use of a separate "B" battery for the detector prevents howling from coupling effects as the batteries become run down. A tap switch on the antenna coil of the first high-frequency transformer, A, permits increasing or shortening of the electrical length of the antenna. Taps are provided at the second, fourth, eighth, sixteenth and thirty-second turns of the primary winding; this feature makes it easy to adapt the receiver for use on different sizes of antennas and for varying distances from broadcasting stations. It also makes it possible to vary the degree of selectivity and provides a means of controlling the energy input to the detector circuit to avoid overloading the detector tube.

A special isolating circuit consisting of a grid choke, J1, and a fixed condenser, K2, is used to isolate the tuning condenser circuits of condensers E, F and G from the low-frequency circuits of transformer H1, thus eliminating the body capacity effects usually found in unshielded receivers.

Variable condensers E and F are ganged together for simplified operation and a small auxiliary tuning condenser, G, is provided for fine tuning.

A 2-ohm rheostat, N1, gives a fine adjustment of filament voltage for all vacuum valves.

Valves of the UX-201-a type are used for the first high-frequency and second low-frequency valve, I1, and for the second high-frequency and first low-frequency tube, I2. A UX-200-a type valve should be used as the detector, on account of its sensitivity with volume and noiseless operation on distant stations. This type of valve usually requires a few minutes before it warms up, but it will then give reception with remarkable sensitivity. A UX-171 type power valve should be used for the last valve, I4. This type of tube will give full volume without distortion or overloading. High "B" battery voltages are sometimes recommended when this valve is used, but excellent results will be obtained with 135 volts of "B" battery. A negative grid bias is provided for all the amplifier valves, thus increasing battery and valve life and also eliminating distortion and overloading.

How to Build the Receiver

The construction of the receiver is a simple matter. The parts are easily mounted on the drilled panel and the wood baseboard. While it is possible to get good results even though the location of the parts is changed, best results with a minimum expenditure of time and effort will be obtained by following the layout shown in Figures 1 and 4.

After all the parts are mounted, you can proceed with the wiring of the receiver, using the flexible wire provided with the kit. All the grid connections and most of the plate connections should be made on the top side of the baseboard, Q, to keep the leads short and avoid interaction and pickup. Most of the rest of the wiring can be done by running the longer leads through the baseboard and along the under side. In running the leads, work on the principle that a straight line is the shortest distance between two points.

The exact wiring of the instruments in the receiver, and the connections for the antenna, ground, reproducer and batteries are clearly shown in Figure 1, and do not require any further explanation.

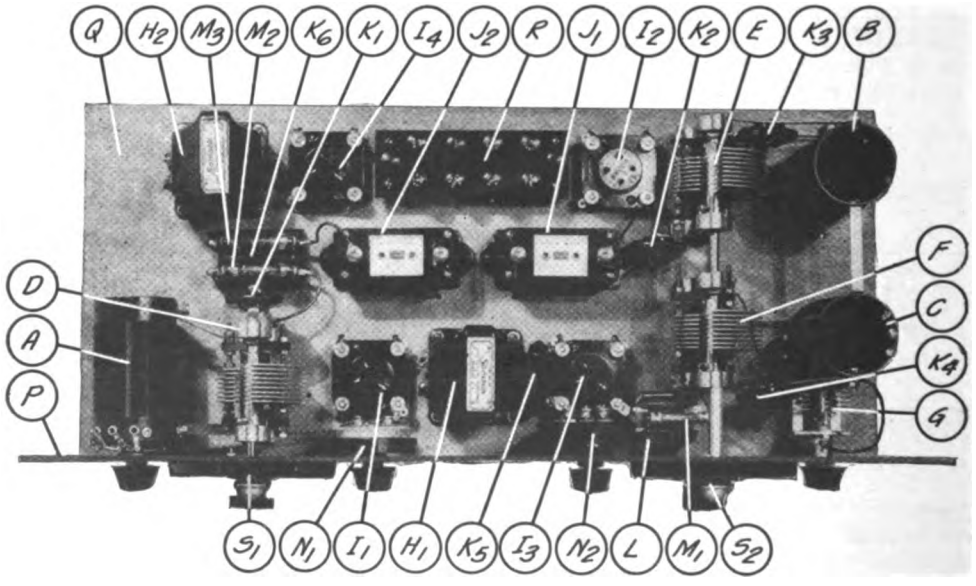
How to Operate the Receiver

While the operation of the receiver is a simple matter, a few pointers will prove of value in getting maximum efficiency in tuning.

The pointers on the antenna, battery and volume control knobs (see Figure 2) should be set to the dots on the panel when the knobs are turned as far as they will go in a counter-clockwise direction. The pointer on the vernier knob should be set to the dot when the rotor plates of the condenser are half out. The tuning condenser dials, S1 and S2, should be set to the "100" position when the rotor plates are all in mesh with the stator plates of the condensers.

To get the set into operation, turn all the knobs so that the pointers point directly up toward the top of the panel. Then tune in a local station having a wavelength of about 400 meters. Loosen

(*Continued on page 573*)



A VIEW OF THE SET FROM ABOVE

FIGURE 4: *This shows the general arrangement of the apparatus on the baseboard and on the front panel. The neat arrangement makes for ease of assembly and also simplifies the wiring of the instruments.*

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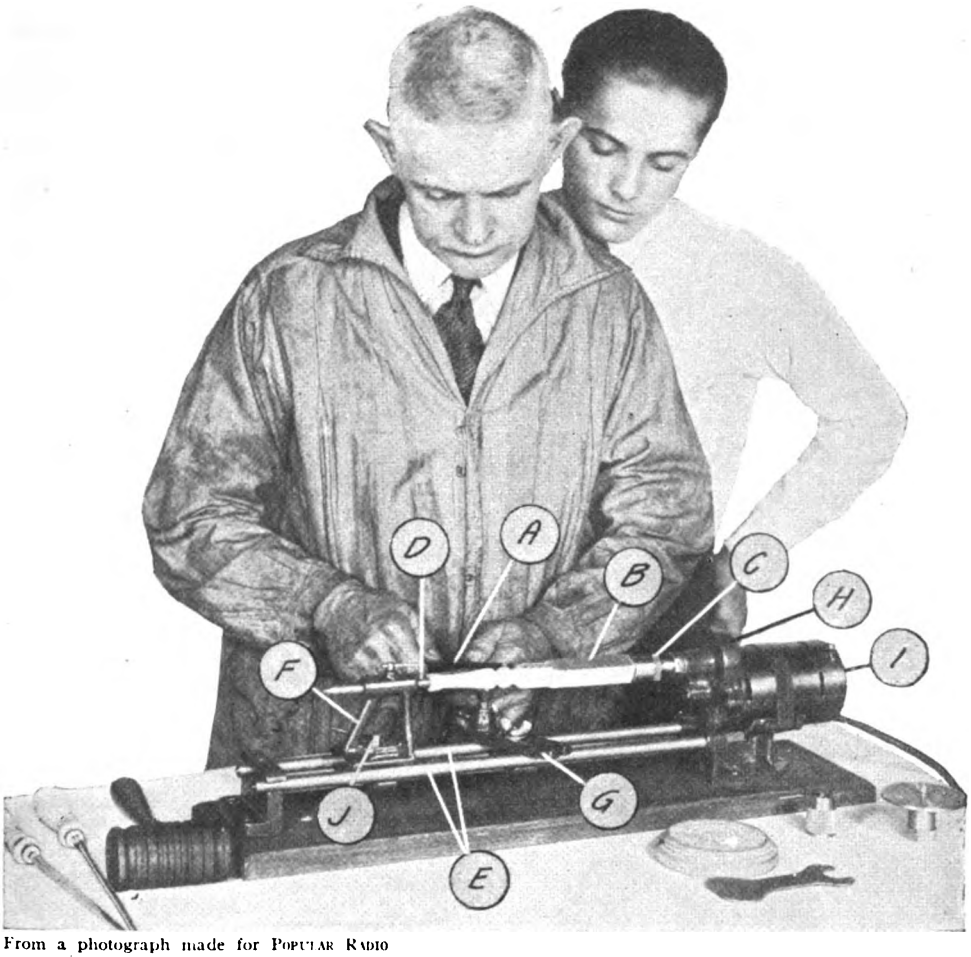
This series of articles is designed for the particular benefit of the home experimenter—for the radio fan who wants to increase his efficiency and add to his pleasure by the correct use of the common laboratory tools.



From a photograph made for POPULAR RADIO

THE LATHE IS EASY TO OPERATE—ONCE YOU GET THE "FEEL" OF THE CUTTING TOOLS

This compact little lathe (shown above doing a turning job), may easily be mounted on your regular work bench and still leave plenty of room for other tools. I is the electric motor, H the gear case, C the spur center, B the work being turned, A the hand-cutting tool, D the dead center, G the tee-rest, F the tail stock casting, J the clamping nuts, and E the bed rods.

Your Laboratory Tools

ARTICLE NO. 3

No radio experimental laboratory is complete without some sort of lathe—which is capable of doing an astounding number of jobs. Here, for example, are some practical pointers on the use of a light, power-driven, compact and easy-to-operate lathe that is peculiarly suited to the needs of the amateur.

By LOWELL MADDEN, JR.

DURING the past two years there have appeared on the tool market a variety of light, power-driven lathes that offer to the home experimenter amazing possibilities in power machinery.

Equipped with such a tool, the ingenious experimenter who dabbles in mechanics may give expression to his creative urge in a number of different ways. For example, he can make decorative radio cabinets; he can turn wood into all sorts of fancy shapes; he can saw bakelite; he can drill, polish, turn light metal and, indeed, do a dozen other laboratory chores that are well beyond the capacity of hand tools.

For after all, a lathe is nothing but a "powerized" combination of hand tools which affords greater output and greater accuracy.

The particular machine that we are

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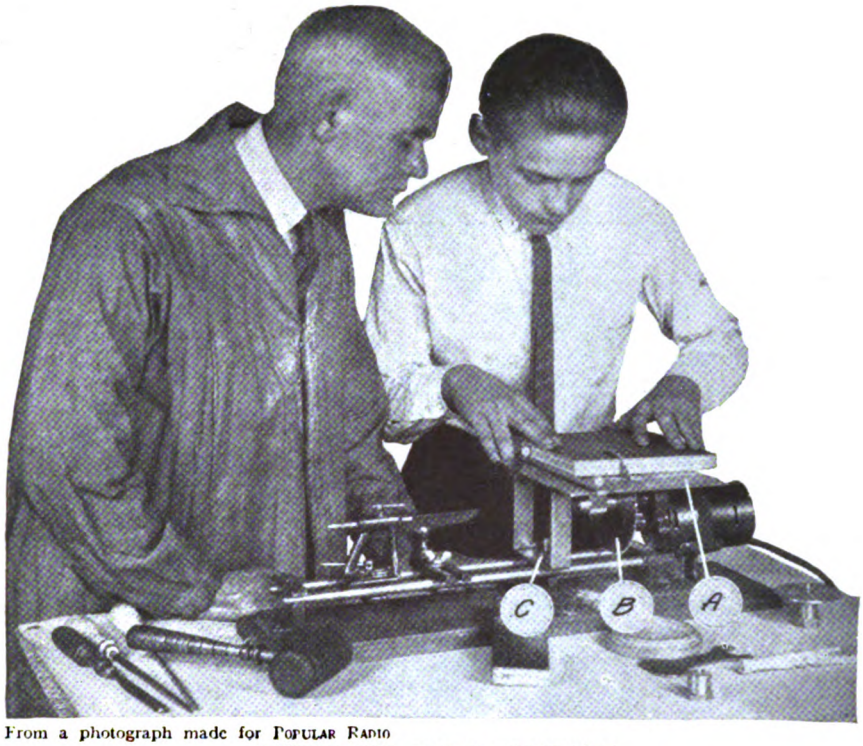
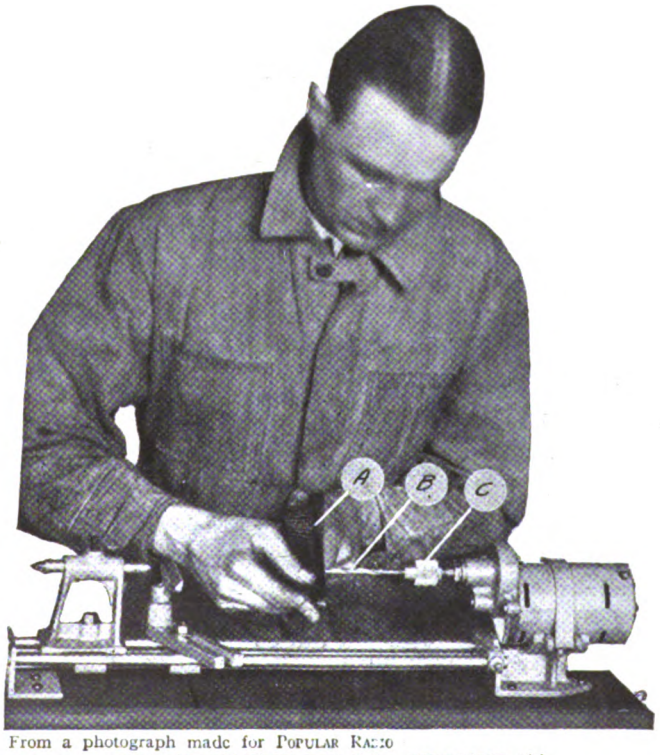


From a photograph made for POPULAR RADIO

FASTER AND MORE ACCURATE

FIGURE 1: *Sawing wood at high speeds with a lathe takes much of the hard work out of building a radio cabinet—and in addition, it makes a better job. The average experimenter will have no trouble in turning out, with the aid of this lathe, many times the amount of work he could do by hand. A is the saw table, B the saw, and C the saw table clamping nut.*



From a photograph made for POPULAR RADIO

POWER AT THE PLACE YOU NEED IT

FIGURE 2: *With the lathe turning the drill, the experimenter can give his whole attention to the work he is doing, and so avoid ragged or crooked holes. In this picture the operator is resting his wrist on the tee-rest; this gives him a steadier grip on the work. The drill chuck is shown at C, the drill at B, and the work at A.*

considering in this instalment is known as the Speedway lathe. It is an example of the tendencies in design at present being followed by a number of light tool manufacturers. Technically, it is known as a "motor in the head lathe," for that is the proper name of the big factory lathes that are driven by electric motors mounted on the live spindle.

In this particular instance, the live spindle of the lathe is the spindle of the motor itself, operating through a small train of gears. As the motor is a high-speed device, the gears are used to reduce this speed and to deliver more power to the work.

A feature of this particular tool is the detachable motor, which is held in position at the end of the lathe bed by a metal strap. Once detached and provided with its special handle, the motor immediately becomes available as a hand power drill. Not only this, but it can also be pressed into service as a portable polishing and grinding tool; a special arbor is used in this instance.

The bed of the lathe is made up of two rods of cold-rolled steel, upon which slides the tail-stock. Other attachments, such as the tee-rest and saw table, may be fixed in position by the use of clamping nuts.

This lathe is admirably suited to small wood-turning jobs, for it has sufficient speed and ample power for all work of this sort—provided that the operator is not in too great haste and does not jam his turning tool.

That the reader may have a better insight into the manipulation of the tool, let us take, as a project a simple turning job, that of cutting out and trimming up a base for a candlestick.

To do this particular job, we shall need what is known as a "screw center."

This is like a small face plate provided with an ordinary wood screw attached to its exact center. A flat piece of wood to be turned is cut out (as illustrated in Figure 5) and is attached to the face plate in the manner shown. The first part of the operation involves turning the piece down to the proper diameter; to do this the tee-rest will have to be adjusted so that the operator may manipulate his tool over the periphery. The tee-rest proper should be adjusted so that it is approximately in line with the center of the revolving piece. This having been done, the operator is ready to begin the actual work of turning.

Those who have some knowledge of wood turning will naturally wonder why the dead center is not brought up in position for a job of this nature. In a case of this kind, the operator must use his best judgment. If the piece of

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wood being turned is thin or has a thickness of, let us say, less than an inch, he runs the risk of splitting it if he jams the dead center into place. In the case of a piece of two-inch stock being turned, the problem would be altogether different and the operator might find it advisable to run the dead center up into place. In this particular job it is advisable to do without it.

Professional wood turners are equipped with all sorts, sizes and shapes of hand turning tools, but the amateur operator, especially when he is beginning, will find it possible to get along with two turning tools—a skew and a gouge.

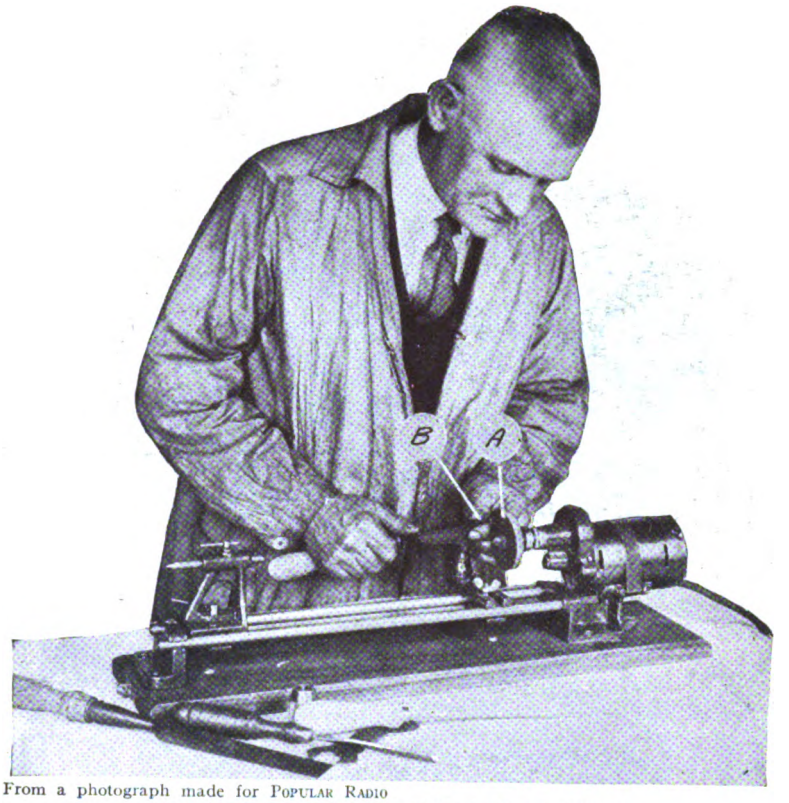
For the kind of work immediately at hand—the turning down of the piece of wood to a definite diameter—the gouge may be used.

The beginner is cautioned to proceed slowly until he becomes acquainted with the "feel" of the tool and until he discovers the real cutting capacity of the motor. He can start out with a light cut and gradually increase it until he senses the critical speed. In taking this cut, the tool should be gripped rather tightly and brought to the proper position on the tee-rest. As the cutting proceeds the operator should learn to work the tool from right to left, taking off a cut of the proper depth on each movement.

After the piece is trimmed down to the proper diameter, the workman may continue to put the proper molding on the edge. It is always best to have this sketched out on a piece of paper. As a general rule, improvised turning, like improvised music, does not work out successfully or artistically. The actual turning is followed by severe application of sandpaper, starting out with a fairly coarse grade and working down to a light grade

In turning out such a thing as a leg for a radio cabinet, a slightly different practice would be followed. To offset the danger of splitting, the screw center is replaced by a spur center. This spur center is provided with sharp projections that pierce the wood, thereby permitting the power from the lathe spindle to be delivered to the work. A special spur center for this use is part of the standard equipment of the lathe. Naturally, the tail-stock center must be employed on a piece of work of this nature. A few drops of oil should be put on the wood where the tail-stock center engages it. If this is not done the friction caused by the revolving wood may be so great as to heat the tail-stock center to a point where it will become soft, and no careful mechanic wants a soft lathe center.

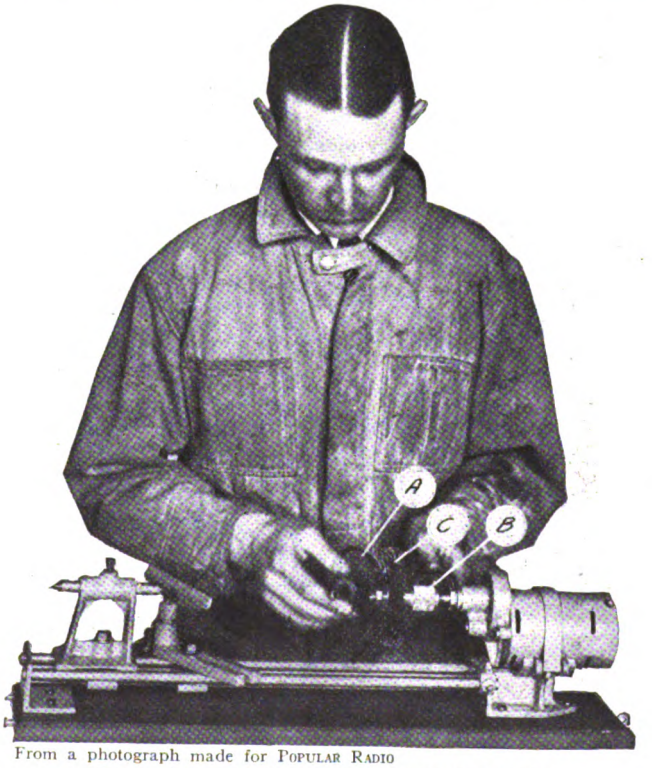
(*Continued on page 580*)



From a photograph made for POPULAR RADIO

IT HELPS TO KEEP THE TOOLS IN SHAPE

FIGURE 3: *A power-operated grinding wheel permits two-fisted sharpening of tools—the best way to get keen edges. The lathe requires sharp tools to produce good work; blunt tools will frequently jam and cause injury to both the machine and the work. The grinding wheel is shown at A and the tool to be sharpened at B.*



From a photograph made for POPULAR RADIO

AN EASY WAY TO MAKE THINGS SHINE

FIGURE 4: *The lathe with a wire brush attachment will make metal work as bright in finish as manufactured articles. B is the chuck holding the wire wheel C, and A is the work, a metal casting being polished prior to lacquering. Buffer wheels for fine polishing work can also be used with the lathe.*

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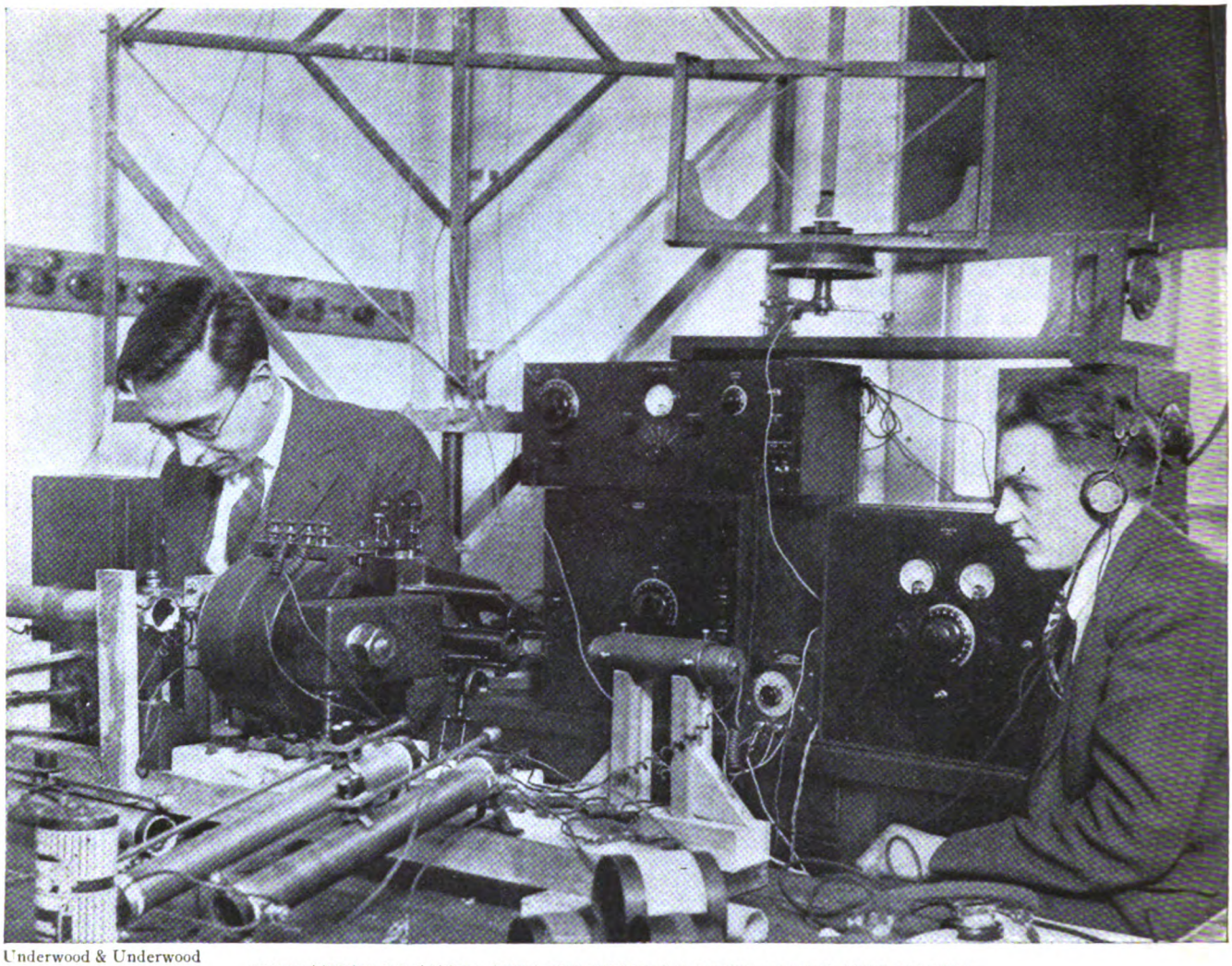

Underwood & Underwood

HOW THEY LOCATED THE HEAVISIDE LAYER ABOVE THE EARTH

Here are Dr. G. Breit (left) and Dr. M. A. Tuve (right) with part of the apparatus with which they obtained scientific evidence of the existence of the Kennelly-Heaviside layer and located its position in the earth's blanket of air. Their researches establish many theories about this phenomenon.

THE FIRST SCIENTIFIC EVIDENCE OF THE EXISTENCE OF

The "Radio Ceiling"

Readers of POPULAR RADIO are familiar with the theory that there is a blanket of air at some undetermined distance above the earth and that this blanket acts as a reflector of radio waves; the April issue contained the latest data on this interesting subject. Since then, however, two scientists have collected what is probably the first evidence—evidence so convincing as to constitute proof of the existence and location of this layer. Here it is.

By UTHAI VINCENT WILCOX

FOR nearly a quarter of a century it has been supposed that there is a layer in the upper air that serves as a good conductor of magnetic energy. It has been believed that the layer contains free ions and electrons which may have emanated from the sun, and that it is the presence of these that makes it a good conductor.

Now come Dr. Breit and Dr. M. A. Tuve, of the Department of Terrestial Magnetism of the Carnegie Institution of Washington, D. C., to demonstrate for the first time that such a layer exists. They have measured its effective height above the earth and learned somewhat of how it affects transmission.

It had long been suggested that if there were such a layer, the upper portions of a given radio wave would move through the earth's atmosphere at a

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greater velocity than the lower portions of the same wave, which move where conductivity is not so good. In consequence, it was thought, the top of the wave front would be accelerated beyond that of the lower part, causing the wave to bend forward and ultimately bringing it to the earth.

Ocean waves toppling over forward as they approach the beach crudely illustrate what was thought to be one effect of this conducting layer in the upper air. According to theory, the layer acted as a "ceiling," bending or reflecting radio waves back to earth.

The investigators reasoned that if this theory were correct, then a receiver at a given point on the earth's surface would record at least two pulses for every pulse at the sending station. One of these would reach it by a direct horizontal path through the air; the other would travel by way of the "ceiling," reaching the receiving station as an "echo" or "reflection." They reasoned further that if this were the case, then the reflected wave, since it traversed a greater distance, would reach the receiver a little later than the direct wave, and that this difference in time might be measured.

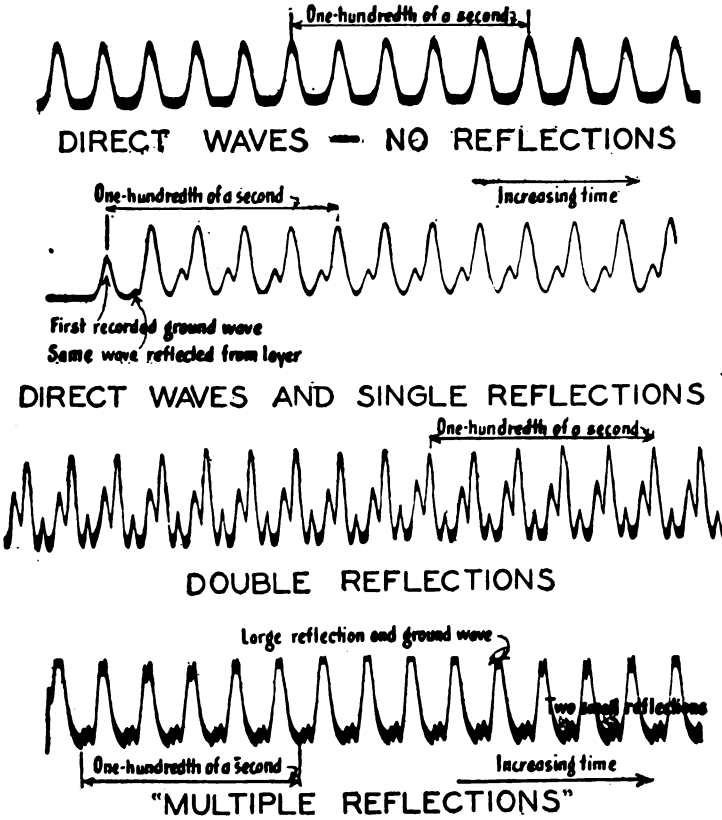
To test these assumptions the investigators set up a receiving station, R (shown in the diagram at the bottom of this page), eight miles from the transmitting station, T. Interrupted trains of waves were sent from T, each train having a duration of about 1/1000 of a second. At the receiving end the signals were detected, amplified and recorded by photographing the tracings made by an oscillating marker.

The photographic records showed conclusively that under certain circumstances each signal was registered twice, and that, in accordance with the assumption, there was an appreciable interval of time between them.

In this manner, through a series of experiments extending over many months, a technique was developed which enabled the investigators to demonstrate experimentally that a transmitted signal, depending upon conditions, reached the receiving station by two paths; the direct path, TR, and the path by way of the "ceiling," TLR. Furthermore, knowing the distance between stations and knowing the retardation of the reflection and the speed of radio waves, the height of the layer was readily computed and found to be about 100 miles, though it appeared to rise and fall during the period observed within a range of from 50 to 130 miles.

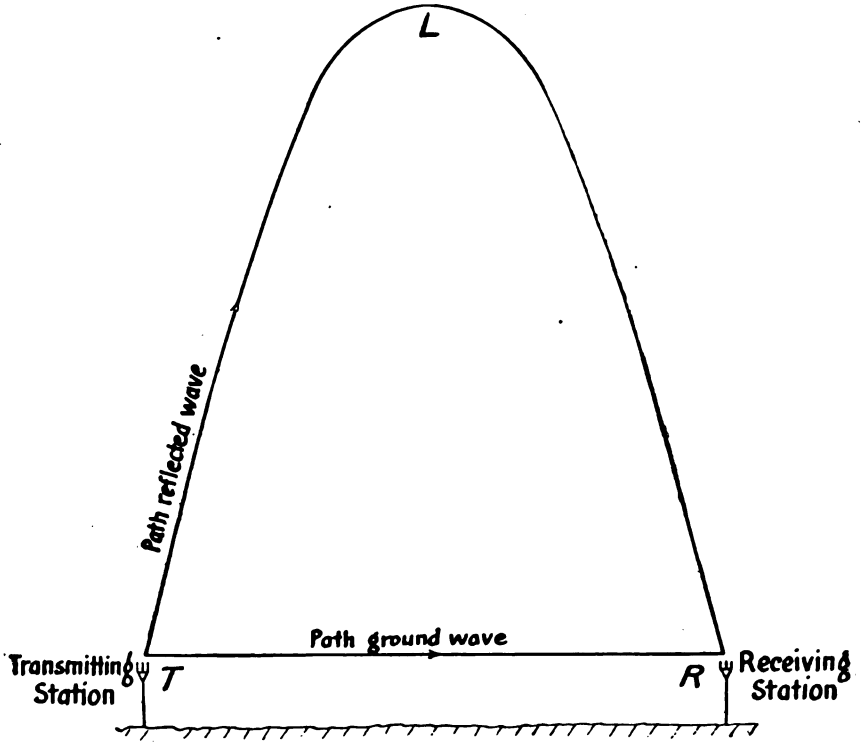
Although these experiments do not tell whether radio waves are actually reflected or refracted by the layer, they

(*Continued on page 581*)



HOW RADIO WAVES ARE REFLECTED FROM THE UPPER AIR

A comparison of three lower wave-trains with the one at the top shows how waves reflected from the Kennelly-Heaviside layer differ from direct waves. The highest projections are made by direct waves; the smaller projections are caused by reflection.



HOW THE REFLECTING LAYER WAS LOCATED

The waves that went to the upper air and were reflected, following the path TLR, reached the receiver R later than the waves that took the direct path TR. Knowing the speed of radio waves, it was a simple matter to determine the height of the reflected layer.

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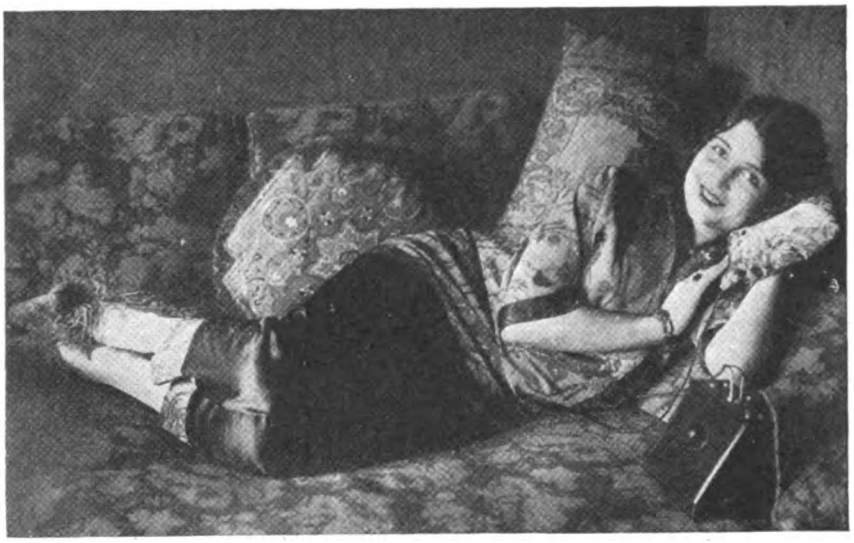


Henry Miller

A NOVEL "RADIO PILLOW"

A radiophone concealed in what appears to be an ordinary small cushion for the divan is one of the season's novelties that is amusing the radio fans of Europe; the above picture shows Claire Rommer, the German film star, listening in.

What's New *in* Radio

Conducted by

THE TECHNICAL STAFF

Inventors, experimenters, manufacturers and readers generally are invited to keep the Technical Staff of POPULAR RADIO informed of all new apparatus that is of their own creation or that comes to their attention; if the apparatus passes the tests of the POPULAR RADIO LABORATORY it will be duly recorded in this Department for the information and benefit of all.

A Special Valve for High-Frequency Amplification

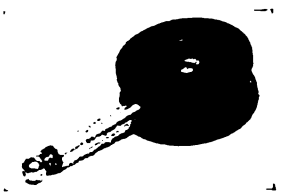
Name of instrument: "Ceco type K special radio-frequency valve."

Description: This new vacuum tube is similar in appearance to the standard UX-201-a type valve. The filament draws ¼ ampere at 5 volts and the plate voltage used may be anywhere from 67 to 140 volts. The valve is especially designed for use as a high-frequency amplifier and may be used for this purpose in most receivers. Its purpose is to increase the sensitivity of the receiver. Its characteristics are somewhat different from those of the UX-201-a type valves and for this reason it should not be used in manufactured neutrodyne receivers, unless facilities are available for rebalancing the neutralizing equipment of the receiver.

Usage: As an amplifier valve in the high-frequency stages of a receiver.

Outstanding features: Provides increased sensitivity in the high-frequency amplifier. Good construction. Long life.

Maker: C. E. Mfg. Co., Inc.



A Handy Phone Plug

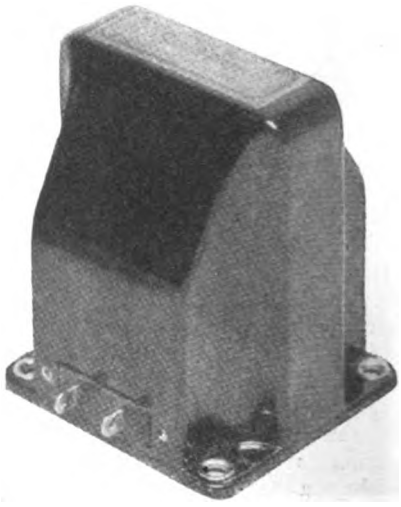
Name of instrument: "Twistit" phone plug.

Description: This plug consists of a composition body with a metal shaft and tip well insulated from one another. Two holes are provided in the edge of the body, into which the phone tips are inserted, after which a twist of one of the sides of the composition body anchors the tips firmly. To withdraw the tips, the side of the body is twisted in the opposite direction and withdrawn.

Usage: As a plug for use in making connections with a jack.

Outstanding features: Provides a positive grip on the tips of the reproducer or headphone cord. Eliminates strain on cord when removing tips from plug, because when loosened the gripping action is completely eliminated.

Maker: Kirkman Engineering Corp.



A High-grade, Low-frequency Amplifier Coupling Unit

Name of instrument: Dual impedance unit.

Description: This dual impedance is entirely enclosed in a neat metal case with a flanged base, in which are provided the necessary screw holes for mounting the instruments. The four terminals project through the steel case and are mounted on composition insulating strips.

Usage: As a coupling unit in a double-impedance, low-frequency amplifier circuit.

Outstanding features: Rigid construction. Convenient arrangement of terminals. Neat appearance. Compact. Excellent quality of reproduction when used in conjunction with standard vacuum tubes.

Maker: Samson Electric Co.

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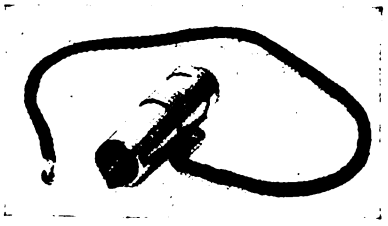


An Accessory That Gives a Check on the "A" Battery

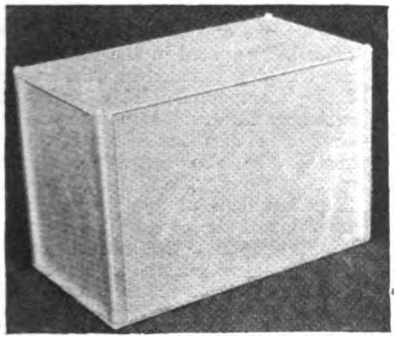
Name of instrument: "Ga-jit" "A" battery tester.

Description: This device consists of a nickel-plated metal tube inside of which is an electromagnet with a counterweighted plunger. To this plunger is attached a calibrated metal scale. There are two pointed terminals on the device that are to be touched to the two terminals of the storage battery to be tested. When the instrument is connected across the storage battery, the magnetic action draws the plunger and the calibrated scale upward and causes part of the scale to project through the top of the metal case. The distance that the scale projects out of the case is determined by the voltage of the battery under test. It is this latter fact that explains the operation of the device. A fully charged battery has a high voltage and will force the plunger all the way out, while a partly discharged battery with a lower voltage will force the plunger only part of the the way. Thus the scale is calibrated to show "low," "medium" and "high."

Usage: To test the charge condition of a 6-volt storage "A" battery.

Outstanding features: Provides accurate indication of the state of charge of a storage battery. Eliminates the necessity for using a hydrometer and does not even require that the battery cells be opened. Handy.

Maker: General Instrument Corp.



Knock-down Shields Made in All Sizes

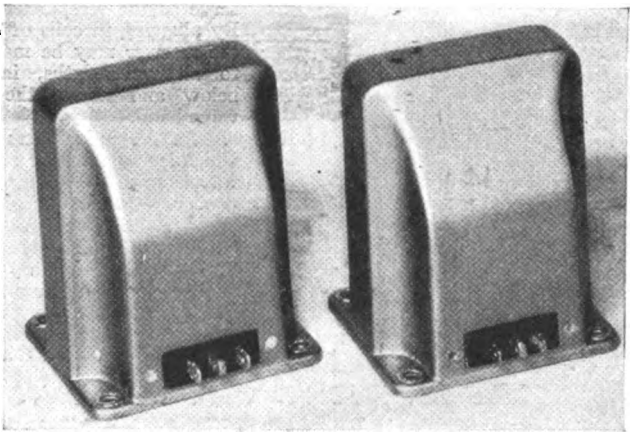
Name of instrument: Shields for high-frequency amplifiers.

Description: These shields may be obtained in knock-down form, and may be purchased to make up into complete shields of any desired size. The shield consists of four corner posts which are slotted to accommodate the sides and ends of the shields. These posts may be obtained cut to any length, and the sides, ends, top and bottom sheets may also be obtained in any size required. The sheets and corner posts are all of aluminum. The sheets are approximately 5/64 of an inch thick while the corner posts are made in approximately ¼-inch angles. To assemble a shield, the four corner posts are mounted in a vertical position on the bottom sheet, by means of four screws which pass through the bottom and up into threaded holes in the ends of the corner posts. The sides and ends of the shields then slide down into position in the slots of the corner posts. The box is completed by mounting the top sheet in the same manner as the bottom, *i.e.*, by means of four screws which pass into the top ends of the corner posts. Partial shields of any size or shape may be made through the use of only two or three corner posts, with as many side sheets as may be required.

Usage: To enable the home constructor to make up stage shields for a high-frequency amplifier of any desired size.

Outstanding features: Aluminum used is of a thickness proven by tests to be the most practical for shielding purposes. Neat in appearance. Easy to assemble. Easy to drill and cut with ordinary tools. Provides good shielding. Component parts may be obtained in any specified size, to be made up into partial or complete shields to fit the requirements of the user.

Maker: Aluminum Company of America.



This Coupling Combination Will Increase Volume and Reduce Distortion

Name of instrument: Push-pull coupling units for low-frequency amplifier.

Description: These two coupling units consist of well-designed and constructed windings and cores of suitable characteristics, entirely inclosed in neat metal housings that are finished in burnished copper. The "input" unit consists of a primary winding and two secondary windings. The latter are connected in series and three terminals are brought out. The two secondary windings provide the input circuits for the two vacuum valves used in each stage of the push-pull type of amplification. The output unit is identical with the input unit in appearance, except that it has only three terminals instead of five. It consists of two impedance coils connected in series. Each of these impedance coils furnishes a path for the direct current from the "B" battery to the plate of one of the valves. The alternating current is shunted through the windings of the reproducer. Each of these units measures 3⅛ by 2½ by 2⅞ inches.

Usage: As the coupling units for use with the push-pull type of amplification, in which two valves are used in a single stage of amplification to reduce distortion and prevent unsymmetrical overloading. It is especially recommended for use in the last low-frequency stage.

Outstanding features: Good design and proportioning of electrical values. Takes up no more room than an ordinary amplifying transformer and an output transformer, except for the space required by the extra vacuum tube.

Maker: Samson Electric Co.

An Inductance That Helps Reproduction

Name of instrument: Choke coil.

Description: This unit consists of an iron-core choke coil inclosed in a metal case. A small inset terminal panel of insulating material is provided. The entire unit is small and measures 2¼ by 2⅜ by 2¾ inches. It has a rated inductance of 30 henries at no load.

Usage: In conjunction with a 4 microfarad by-pass condenser, as an output filter to shunt the high-voltage direct current around the reproducer windings.

Outstanding features: Adequate inductance. Protects the loudspeaker. Compact.

Maker: Jefferson Electric Mfg. Co.

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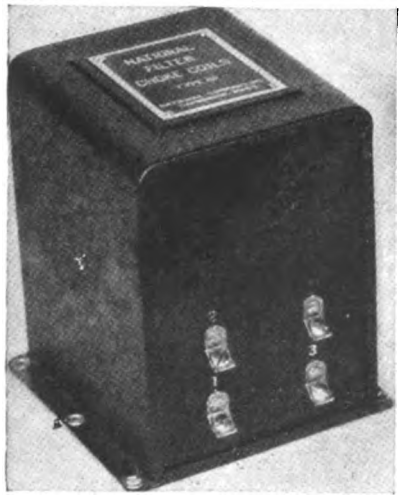
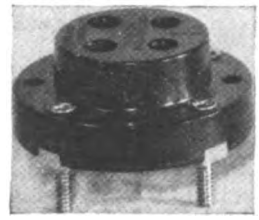


A Choke That Requires Little Installation Space

Name of instrument: Filter-choke coils.
Description: This unit is inclosed in a pressed-metal case. It consists of two iron-core choke coils designed for use in the filter circuit of "B" power-packs where the current does not exceed 80 milliamperes. Separate terminals are provided on the composition panel at one end of the case for the two choke coils within. The two coils can therefore be used singly or in series, as desired.
Usage: As the smoothing inductance for use in conjunction with high-capacity condensers as the filter of a "B" power-pack to eliminate the hum which would ordinarily be present in a receiver which drew its plate supply from the house-lighting lines through a rectifier.
Outstanding features: Small size. Neat appearance. Matches the other "B" power-pack units made by this same company. Can be used as the filter choke in any circuit which requires a high inductance with a current-carrying capacity not exceeding 80 milliamperes.
Maker: National Company, Inc.

Plug-in Coils for All-Wave Receivers

Name of instrument: Plug-in coil.
Description: This is a self-supporting coil with an air core. The coil consists of of a primary and a secondary winding, with provision made for varying the coupling by moving the primary away from the secondary by means of a short length of dowel rod (as shown in the illustration). The coil is permanently mounted on a composition base similar to those used on vacuum tubes. The terminals are connected to the four prongs at the bottom of this base. To use these coils, a receiver is equipped with standard vacuum valve sockets which serve as the receptacles for the coils. By plugging in coils of different sizes, the receiver may be made to respond to all wavelengths, including those below and above the broadcasting wave band.
Usage: As the inductances in a receiver which is intended for reception on all wavelengths.
Outstanding features: Efficient coil windings. Provide variable couplings between cricuits. Firmly mounted. Permit the use of ordinary vacuum-valve sockets for coil mountings. Enable the receiver in which these coils are used to cover all wavelengths.
Maker: Washburn Mfg. Co.



This Valve Socket Simplifies Sub-Panel Wiring

Name of instrument: Vacuum-tube socket.
Description: This socket is molded of bakelite and is equipped with phosphor-bronze spring contacts. The connection terminals are riveted to the bakelite frame and every precaution has been taken to prevent the spring contacts from working loose. The terminal binding posts extend downward so that the socket may be mounted on the top of a sub-panel with the four terminals projecting through the sub-panel and securely fastened to it by means of four nuts provided with the socket. All wiring of connections may then be made underneath the sub-panel.
Usage: As a valve socket in receivers in which the sockets are to be mounted on a sub-panel and the wiring is to be done underneath.
Outstanding features: Firm and lasting contacts. Riveted construction. High quality insulation. Permits all wiring to be done beneath the sub-panel of the receiver.
Maker: Klosner Radio Corp.

A Heavy-Weight Cap to Eliminate Microphonic Valve Noises

Name of instrument: Vacuum valve vibration repressor.
Description: This valve cap is molded from soft lead. It is approximately ¼ of an inch thick at the top but tapers down on the sides to a thin edge. This edge is easily bent with the fingers and when the cap is in place these edges may be bent to conform with the shape of the tube. This insures a snug fit of the cap.
Usage: To be placed on vacuum valves to eliminate mechanical vibration which causes howling.
Outstanding features: Molded in one piece. Polished exterior. Extremely heavy with correspondingly good repressor action. Stops howling in a low-frequency amplifier.
Maker: Mertz Specialty Co.

A Good Filter Condenser for "B" Power-Packs

Name of instrument: Filter condenser block.
Description: This condenser block, known as the Tobe BH filter block, consists of an aluminum finished metal container in which are carried all of the condenser capacities required for the filter in any "B" power-pack which delivers 300 volts or less through a rectifier type BH valve. These condensers are of the "paper" type, and, after being placed in the metal "can," are completely sealed in with an insulating compound. This makes the assembly impervious to moisture and dust and also lends rigidity. The metal case also serves as a shield when properly grounded. There are four terminals at the lower edge of one side of the case. This condenser block simplifies the construction of power-packs because it reduces the amount of space required for mounting the condensers and eliminates much of the wiring that would be necessary if individual condensers were used. The capacities provided by the block are 4, 4 and 6 microfarads. The unit is designed to operate with any DC operating voltage up to 300 volts.
Usage: Provides all filter capacities for a power-pack which uses the BH type rectifier valves.
Outstanding features: Well constructed. Neat and compact. Conveniently located terminals. Will withstand high working voltage. Saves space, time and effort in the construction of a "B" power-pack.
Maker: Tobe Deutschmann Co.

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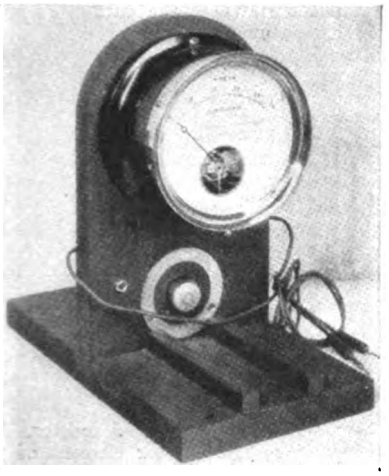


A Practical Battery-Testing Device for Dealers

Name of instrument: "ABC" battery tester.

Description: This device consists of a combination voltmeter five inches in diameter, mounted on a wooden stand and base. It is so designed as to facilitate attachment to the dealer's counter or to the laboratory table. It is equipped with a large, visible scale. Two rubber-covered wires are provided for testing the "B" and "C" batteries. For testing dry-cell batteries, an automatic arrangement is used, whereby the battery is placed on the two wooden strips on the base and is pushed against the metal ring and button shown in the illustration. The meter functions as an ammeter for testing dry cells, but for "B" and "C" battery testing it functions as a voltmeter with a range of 0-50 volts.

Usage: For testing "B" and "C" batteries and also dry-cell "A" batteries.

Outstanding features: Convenient to use. Large and easily readable scale. Foolproof, in that "B" and "C" batteries cannot be connected to the circuit provided for testing 1-1.2-volt dry cells.

Maker: Burton-Rogers Co.

A Power-Pack Operating on DC Lighting Lines

Name of instrument: Varion DC power-pack.

Description: This is a well-constructed power-pack. It contains the necessary choke coils, condensers and resistances for the filter, all mounted on a composition base and inclosed in a ventilated metal housing. On the outside of the case, at one end, is an insulating panel which carries the output terminals and the control knobs for varying the filament voltage and the detector plate voltage. Immediately above this panel is a voltmeter with a scale which reads up to 8 volts. This permits an exact adjustment of the filament supply voltage. The meter is connected across the filament terminals and shows the exact filament voltage supplied to the receiver. The unit supplies an adjustable detector plate voltage and fixed voltages for the high-frequency amplifier, and high voltage for the last low-frequency amplifier stage. This latter voltage is almost equal to the line voltage, usually slightly less than 110 volts.

Usage: To eliminate all batteries and supply all necessary filament and plate voltages for the operation of any radio receiver from the direct-current lighting lines.

Outstanding features: Eliminates all batteries. Reliable in operation. Completely inclosed. Well ventilated. Contains a voltmeter to permit exact adjustment of filament supply voltage. Neat appearance.

Maker: Morison Electrical Supply Co.

A Double-Impedance Coupling That Gives Lifelike Reproduction

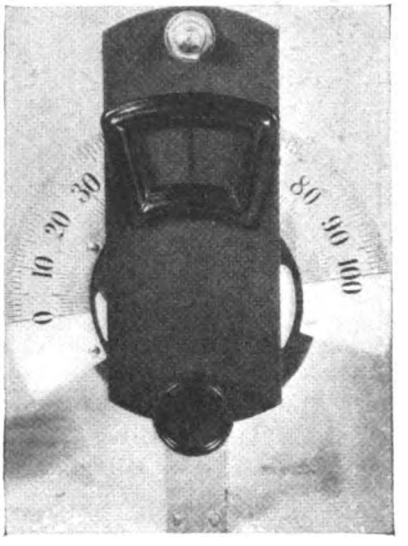
Name of instrument: Double-impedance coupling unit.

Description: This unit consists of two impedance coils and a fixed condenser. These three units are included in a single metal case. All internal connections are made before the instrument case is sealed. Four external connection terminals are provided in the form of binding posts near the bottom of the case, which is flanged and eyeletted for mounting screws. The impedance coil and the condenser values are so selected as to provide high amplification at the very low frequencies.

Usage: To provide intervalve coupling in the low-frequency amplifier portion of a radio receiver.

Outstanding features: Provides high amplification at all frequencies, especially at the extremely low frequencies that are neglected by many low-frequency coupling devices. The appearance and terminal arrangement of these units are much like those of low-frequency transformers and they are connected into a circuit in the same way. They are, therefore, ideal for use as a substitute for poor transformers in revamping an old receiver. Neat in appearance. Efficient.

Maker: General Radio Co.



An Illuminated Tuning Control

Name of instrument: Illuminated tuning control and pilot light combination.

Description: This device consists of an adjustable metal framework on which the instrument to be controlled is mounted. This framework may be mounted directly on the rear of the receiver panel. A celluloid dial rotates behind the panel but is visible from the front of the receiver through a small, rectangular, bezeled window. This scale, which is calibrated in degrees, rotates with the moving section of the condenser or other tuning unit and both are controlled by a small tuning knob on the panel just below the window. The knob provides a vernier control with a ratio of approximately 8 to 1. A small lamp is mounted just behind the calibrated scale in such a position that a beam of light will be shown through the translucent scale. This makes it easy to read the indicator settings, even in the dark. The lamp also serves as a pilot light, in that it may be connected to the circuit in such a way that it is turned "on" and "off" with the receiver. Where it is not desired to take advantage of this feature, the separate, small switch, that is mounted on the framework of this instrument may be used to turn the lamp "on" and "off."

Usage: As a tuning control to be mounted on the panel of a radio receiver.

Outstanding features: Provides good vernier control. Neat in appearance, when mounted on a panel. Has self-contained switch or may be operated automatically by the filament-control switch of the receiver. Plainly calibrated scale. Illuminated from within. Template is furnished to simplify the drilling of the panel for the installation of this device.

Maker: Pilot Electric Mfg. Co., Inc.

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Underwood & Underwood

A New Radio-equipped Automobile

A receiving set installed on the dashboard is one of the latest things in automobile accessories; it is compactly and conveniently arranged so that the driver may tune in as he rides—if he is a steady driver. The loudspeaker may be seen, installed just above the windshield.

This Unit Keeps Your Storage Battery Charged at All Times

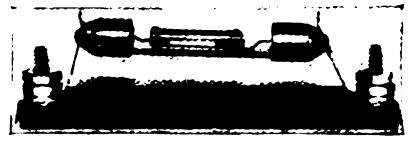
Name of instrument: Trickle charger for storage "A" batteries.

Description: This device consists of a transformer and an electrolytic rectifier. The transformer case and the rectifier base are molded in one piece. The glass rectifier jar sets down into this base and is held firmly in position by a heavy metal conductor which extends from the rectifier to one of the output binding posts of the transformer case. A non-acid electrolyte is used in the rectifier. The unit will charge a storage battery at approximately a .6 ampere rate.

Usage: To be connected to a storage battery at all times when the receiver is not in use. This provides a small continuous charge, which will keep the battery constantly in good condition.

Outstanding features: Compact size. Neat appearance. The use of a glass container for the rectifier permits the operator to see at a glance when additional water is required.

Maker: France Mfg. Co.



A Fixed Resistance That Is Sealed in a Vacuum

Name of instrument: Fixed high resistance unit.

Description: This resistor, which is known as the Tobe "Tipon" Loewe resistance, consists of a glass tube which is coated with a resistance material, the resistance of the units depending on the density of the coating. The connecting wires are sealed in the glass tube and the resistance coating extends out on to these wires, thus insuring perfect contact. The entire assembly is inclosed in another and larger glass tube and the air is evacuated, thus providing a vacuum container for the resistance which protects the resistance element from atmospheric moisture, oxidation and deterioration. This precaution results in a constant resistance value and noiseless operation. Silver-plated metal ends are mounted on the glass container to insure good external contact when this unit is used with any standard type of resistance mounting. These resistances are made in various sizes, ranging from 10,000 to 10,000,000 ohms.

Usage: As resistance units for resistance-coupled amplifiers, grid-leaks, or other purposes where the current does not exceed one watt.

Outstanding features: Permanent resistance values. Close ratings of resistance values. Resistance sealed in a vacuum.

Maker: Tobe Deutschmann Co.

This Grid-Leak Helps to Eliminate So-Called "Tube Noises"

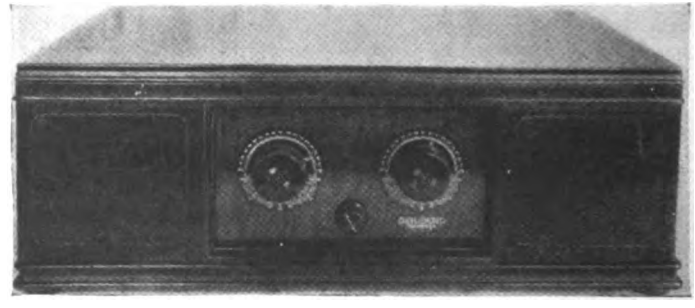
Name of instrument: Fixed resistor.

Description: The resistor element of this device is unique in that it is fused into glass. The resistance element itself is made up of a closely set material, which furnishes an uninterrupted path for the flow of current and which has much more permanent characteristics than had many of the older type of grid-leaks which made use of a crystalline formation in the resistance element. The small glass tube into which the resistance element has been fused is completely inclosed in a larger glass tube which is equipped with metal caps at each end. The ends of the resistance terminates in these caps. This resistor is installed in the same manner as any of the cartridge-type grid-leaks—by slipping into a standard mounting.

Usage: As a grid-leak or for any other purpose where a fixed resistor of values from 500 to 10,000,000 ohms are required.

Outstanding features: Stable characteristics. Noiseless in operation. Well made. Guaranteed accurate within 5 per cent of rated value.

Maker: Amsco Products, Inc.



A New Receiver That Operates Entirely From the Lamp Socket

Name of instrument: Walbert Model 26-PT Receiver for lamp socket operation.

Usage: For the reception of broadcast programs.

Outstanding features: Absolute freedom from AC hum. Operates from any line voltage between 110 and 125, and frequencies from 50 to 60 cycles. Requires no upkeep attention. Excellent tone quality and selectivity. Pleasing appearance. Easy to operate. Requires only the push of a button to place in operation. May be logged. Dial settings for a given station always remain the same with this receiver.

Description: Nothing could be more simple or fool-proof than the installation and operation of this receiver.

There are no batteries to bother with. In installing the receiver in the home it is only necessary to place the seven AC valves in their sockets, connect the antenna and ground wires to their binding posts, insert the tips of the reproducer cord into two small jacks, provided inside of the receiver for this purpose, and insert the power plug into the nearest lamp socket. The receiver is then "all set to go." Thereafter pressing one button starts the receiver, and pressing another turns it off!

Tuning is accomplished by means of two knobs on the front panel of the

(Continued on page 576)

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A Receiver That Is "Different"

Name of instrument: Leutz Universal Transoceanic "Phantom" receiver.

Description: The radio public has become so accustomed to have its receivers inclosed in mahogany and walnut cases that a receiver not thus housed comes as a shock to many. The "Phantom" receiver strikes a new note in external design, in that it is housed in a dull-finished, natural-color aluminum case with all tuning and other controls set in contrasting black.

To many radio enthusiasts this arrangement is attractive. However, to those who prefer the more usual form of housing for the receiver, special cabinets of wood may be obtained from the manufacturer.

It has been the manufacturers' intention to provide in this set extremely high efficiency, and to include nothing that does not make toward this end.

The greatest possible leeway has been provided to permit the owner to adapt this set to his needs. Any type of power valve may be used in the last low-frequency stage. Any sort of "B" power may be used—dry "B" batteries, storage "B" batteries, or a "B" power-pack. The tuning may be limited to as many or as few controls as desired—anywhere from one to five, as will be explained later. Any sort of an antenna may be used—loop, indoor or outdoor. The receiver is equipped with plug-in coils to cover the broadcast waveband, and other coils may be obtained which will permit the receiver to cover all wavelengths from 35 meters up to 3,600 meters.

The receiver consists of four stages of tuned high-frequency amplification, a vacuum valve detector and four stages of low-frequency amplification. This requires the use of nine valves in all. Each of the high-frequency amplifier stages is shielded separately and the complete low-frequency amplifier is totally shielded from the rest of the receiver. The aluminum case serves as part of this extensive shielding system, and also provides practically total shielding for the entire receiver against all outside disturbances.

THE "PHANTOM" IN OPERATION

Here is this novel receiver operating with the Leutz "B" power-pack—which may be seen to the right of the set. The dull metal finish of the set is a new departure in cabinet design.

Each high-frequency stage is provided with a variable tuning condenser, as is the detector circuit. Thus there are five tuning condensers in all, and each is operated by a tuning control which projects through the front of the receiver. A novel feature of this arrangement, however, lies in the fact that the rotors of these five condensers are provided with hollow shafts. These shafts are all in line, and a metal rod is slipped through them. By tightening the set screws in the shafts the rotors of the condensers can be made fast to this common shaft so that they will turn together as a single unit. This means that the receiver can be made to operate by a single control, providing all rotors are tightened on the common shaft. Then, if any one of the tuning controls on the panel is turned, all of the condensers will turn with it and all circuits will be tuned at the same time. In actual practice it is usually considered best to operate the first condenser separately because the values of its circuit vary according to the values of the antenna to which the set is connected. The other four condensers can be tied together to operate from a single control, thus making the receiver a two-control outfit. Small auxiliary adjustment knobs are provided on the front of the receiver to adjust the capacities of three of these circuits so that the tuning controls can be brought into exact synchronism with the fourth.

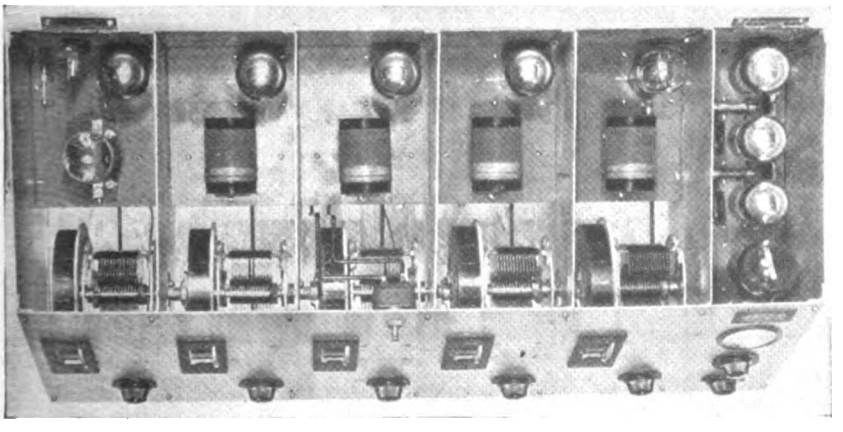
It is not essential, however, that the condensers be coupled together. Tuning with the five separate controls is not nearly so much of a problem as it would appear at first glance. When a given station is exactly tuned in it will be found that all but the first dial show almost exactly the same setting. That is, if a certain station tunes in at a given setting on the second control dial, the third, fourth and fifth dials will all show within one or two degrees of the same reading.

A voltmeter and switch is mounted at the right-hand end of the receiver panel. This voltmeter is one of the attractive features of the receiver, as it will measure every voltage used in the receiver. For instance, if the switch is set on point No. 1 the meter will show the filament voltage applied to the four high-frequency amplifier valves. Point No. 2 gives the detector filament voltage. Point No. 3 shows the "C" voltage applied to the grids of the first three low-frequency amplifier valves. Point No. 4 gives the "C" voltage of the power valve. Point No. 5 shows the voltage applied to the plate of the detector valve and points Nos. 6, 7 and 8 show the plate voltages applied to the high-frequency valves, the first three low-frequency valves and the power valve, respectively.

This voltmeter therefore not only permits the proper filament voltage to be maintained (by means of the two rheostat controls on the receiver front), but also provides an easy check on the other voltages used. This simplifies the proper voltage adjustments where a power-pack provided with variable outputs is used to supply the high voltages. It also serves as a quick check on the voltage of batteries, if batteries are used for the operation of the set.

This receiver will provide best all-around results, of course, when an outdoor antenna is used. In congested areas the length of an antenna

(*Continued on page 578*)



THE SHIELDED COMPARTMENTS OF THE RECEIVER

At the right are the four low-frequency stages in one compartment. The four high-frequency and the detector stages, each in a separate compartment, are seen to the left of the low-frequency compartment. Note also the common shaft for the rotors of the tuning condensers.

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IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

A New Use for Vacuum Tubes

ALTHOUGH vacuum tubes are usually operated in radio under alternating-current conditions, whether used as amplifiers, oscillators or detectors, it is well known that a direct current will pass through a tube when the filament is heated and when a positive voltage is maintained on the plate. This direct current is affected by the grid voltage much as are the more usual alternating currents which we ask our receiving tubes to handle. Indeed, it is by measuring the direct current which passes under these uniform conditions that we obtain the familiar "characteristic" curves indicating the relations between grid voltage, plate current and other characters for any selected tube.

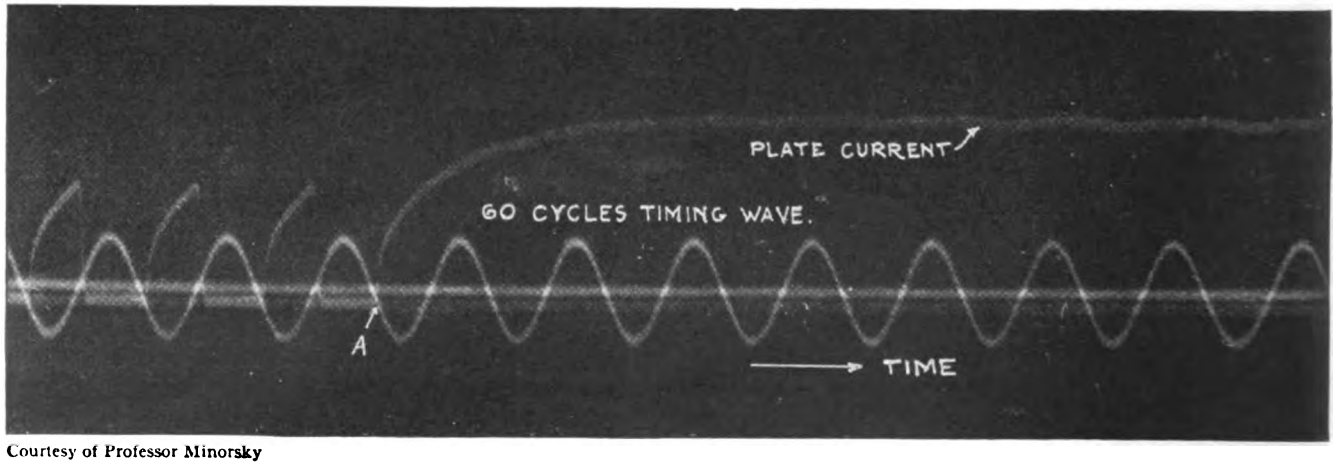
The vacuum tube is really a direct-current instrument as well as one for alternating current. It is merely that practical considerations arising from the nature of radio have conspired to emphasize the oscillatory properties of the tube and to minimize its behavior toward direct potentials.

Important steps toward the enlargement of this relatively neglected direct-current field have been taken in a recent paper by Professor Nicholas Minorsky of the Moore School of Electrical Engineering at the University of Pennsylvania.* Professor Minorsky connected a series of vacuum tubes, with the output of one communicating to the grid of the next, all being supplied with adjusted direct-current plate potentials from points along a potentiometer. When the characteristics of tubes and circuits are related to each other in the proper fashion (for the details of which Professor Minorsky's paper must be consulted) the final tube of the series possesses a peculiar kind of instability by virtue of which a small change of grid potential on the first tube causes the plate current through the final tube to alternate between a high value and a value which is virtually zero. The tube series acts, therefore, as a direct-current amplifier.

Professor Minorsky's term for this action is the "contact effect," which emphasizes the similarity of the action to that of any contact device, such as a switch. By applying a small additional voltage (in the proper direction) to the grid of the first tube a relatively large current may be "turned on" through the plate circuit of the final tube, much as though a switch, previously open, had been closed. As always, the electronic changes inside the tubes are virtually without inertia. Accordingly, the combination acts as an intertialess switch or relay, thus extending to certain direct-current problems this same quick-acting relay principle which is already the secret of many successes of the vacuum tube in alternating-current technique. To close an ordinary switch or an ordinary relay takes both time and energy. The vacuum-tube "contact" device "closes" vastly more rapidly and with much less consumption of power.

One practical application of the device has already been made. This is in the regulation of the voltage of direct-current dynamos. The standard method of doing this uses some variety of voltage-operated relay which will start or break the current passing through a special, additional field-coil of the dynamo, in agreement with the fall or rise of the voltage which the dynamo is delivering. Too low a delivered voltage operates the relay, closes the circuit of the auxiliary field coil, and thus increases the magnetic forces in the dynamo, bringing the voltage back where it belongs.

* "Phenomenon of Direct-Current Self-Excitation in Vacuum Tubes and its Applications," by Nicholas Minorsky. *Journal of the Franklin Institute* (Philadelphia), volume 203, pages 181-209 (February, 1927). POPULAR RADIO is indebted to Professor Minorsky for some additional information concerning his investigations.



Courtesy of Professor Minorsky

HOW A VACUUM-TUBE CIRCUIT WORKS AS A DIRECT-CURRENT RELAY

This oscillograph record was made by the series of vacuum tubes, put together by Professor Nicholas Minorsky, to operate as a relay to make or break a direct current. The regular wavy line is the timing wave, at 60 cycles a second. The curve marked "plate current" indicates how quickly the vacuum-tube relay "closed," permitting the plate current to rise, after the starting signal was given to the first vacuum tube of the series. The time of this starting signal is indicated by the letter "A."

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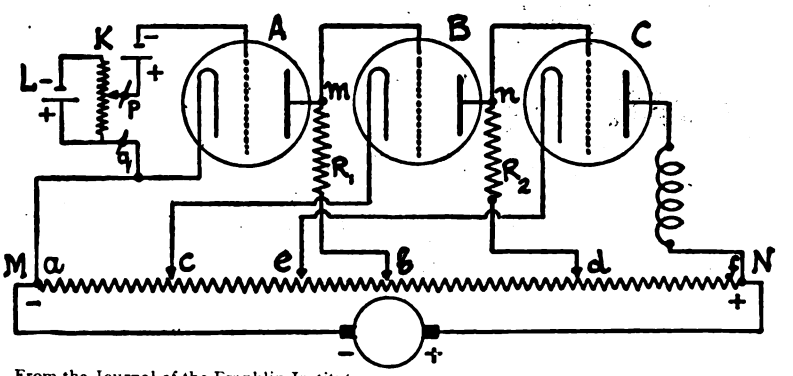
Relays now used for this purpose are mechanical, being operated by some electromagnetic effect of the altered voltage. Although reasonably satisfactory, they have some lag, they absorb some energy and they possess mechanical contact points which may burn out or require adjustment.

Professor Minorsky has applied his new vacuum-tube device to this problem. He reports that it operates excellently, uses very little power, is without inertial lag and does away with the difficulties due to contact points. The "contacts" are the electrons in the tube, not any metallic points or plates.

Professor Minorsky's work is not so much a contribution to radio as one from radio. An instrument developed and perfected largely by the radio industry is shown to have promise of large importance for branches of electrical engineering which have seemed quite remote from oscillators or receivers.



From the Journal of the Franklin Institute

PROFESSOR MINORSKY'S DIRECT-CURRENT AMPLIFIER

The series of vacuum tubes, all supplied with plate voltages from the potentiometer and dynamo, will deliver a large direct current in the plate circuit of the third tube, marked "C," in response to a small signal initiated by the subsidiary circuit at "L" and applied to the grid of the first tube, marked "A." The device has been applied to the regulation of the voltage produced by direct-current dynamos.

Somersaults in the Transformer

EVERY radio fan knows that operation of the familiar iron-core transformers such as we use in our audio-frequency amplifiers involves a rapid alternation of the magnetic forces in the iron-filled throats of these instruments. It is not so well known that these magnetic forces are related to some of the most intimate and important properties of the atoms of iron, as distinct from atoms of other kinds of matter. These facts belong in the science of magnetism, a science which is much less well known to the average radio experimenter than it ought to be.

Twenty years ago the magnetism of iron was very much of a mystery. It is still impossible to claim that all of the mystery has disappeared, but some of it has and the experts who are at work in this field are rapidly dispelling the remnants of ignorance which still remain. Modern theories assume, with ample evidence for the assumption, that the manifestations of magnetic forces on the part of alloys of iron are due essentially to the fact that each tiny atom of iron in the alloy is itself a minute magnet.

Everyone who has experimented at all with electric currents and with magnetic forces knows that the passage of a current of electricity through a circular coil of wire will generate a magnetic force acting along the axis of the coil. This is the so-called magnetizing current, and an arrangement in which a direct current flows through a succession of turns of wire wound in a solenoid, constitutes the familiar electro-magnet. When it is remembered that an atom of matter consists essentially of a number of electrons revolving around the atomic nucleus as planets revolve around the sun, it is easy to see that these continual revolutions of the electric charges which constitute the electrons resemble the much larger revolutions of the electric current through the coils of an ordinary electro-magnet.

Each electron orbit ought to be capable, therefore, of acting as a tiny electro-magnet and of producing a magnetic force extending outward from the atom, just as the magnetic force of an electro-magnet extends outward from the two ends of the coil.

Bell Telephone Laboratories

MAGNETS OBEY HIM

Dr. L. W. McKeehan, of the Bell Telephone Laboratories, has added important facts to our knowledge of the somersaults of atoms in iron alloys as a result of his work with permalloy, the iron-nickel alloy used for cores in submarine cable and for other purposes.

Although we are still unable to unravel all of the details of the electron orbits inside the atom of iron, there is good ground for the belief that these orbits are so arranged in space as to discharge, outside of each atom, a significant amount of this magnetic attraction. In the case of atoms such as those of copper or silver, which are not notably magnetic, the most plausible assumption is that the electron orbits in these atoms are arranged differently; presumably in such fashion that the magnetic force due to one electron orbit is canceled by an opposing magnetic force due to another electron orbit, in which the electron moves, perhaps, in the reverse direction.

According to this theory, if a piece of iron is "magnetized" so that it attracts another piece of iron, affects the compass needle, and so on, it means atomicly that a majority of the atoms inside the piece of iron are turned in directions sufficiently parallel to make the individual magnetic forces reinforce each other.

On the other hand, when we have a piece of iron which is not magnetized we need not assume that the atoms of this non-magnetic iron have lost their individual doses of magnetism. The more reasonable assumption is that the atoms in the non-magnetic iron are arranged at random, with the directions of their magnetic forces in conflict, thus neutralizing each other in so far as any external magnetism is concerned.

It is an obvious corollary of these ideas that when a non-magnetic piece of iron is magnetized this involves, in the atomic world, a turning around of the atoms inside the iron.

Imagine yourself standing on a platform before a great crowd of people. If

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Bell Telephone Laboratories

HONORED FOR TWO KINDS OF COMMUNICATION

Two physicists of the Bell Telephone Laboratories have received the John Scott Medal recently for services to communication; one for aiding messages under the sea, the other for help to messages traversing the ether. At the left is Mr. G. W. Elmen with a strip of the magnetic metal, permalloy, used to "load" cables and permit them to carry submarine messages faster than is possible otherwise. At the right is Mr. William G. Housekeeper holding one of the high-power vacuum valves which he perfected for trans-Atlantic radio telephone communication.

the meeting has not been brought to order and if the members of the crowd are faced entirely at random, some facing in one direction and some in another, you will see from the platform merely the vast black crowd of human individuals. Suppose now that the chairman raps his gavel to call the meeting to order. Instantly, all the individuals turn around (if necessary) so that everyone is facing in a single direction. There then appears to your eye a vast sea of human faces, replacing the former indistinguishable mob.

What happens when a piece of iron is magnetized may be likened to this. The magnetizing force turns around the majority of the atoms so that all of their magnetic forces, corresponding to the people's faces, point in the same direction.

When the phenomena are viewed in this way, it is obvious that certain physical changes not concerned with magnetism may be involved.

To return to our illustration of the crowd of people; if the people are packed very tightly together and if then some stimulus forces them to face in one direction, there will be a good deal of friction as one individual bumps his neighbor in the ribs or is stepped on by his neighbor's feet. The crowd will actually get warmed a little, physically as well as metaphorically.

The same thing happens in a bar of iron when it is magnetized.

The atoms interfere a trifle with each other as they turn around. The iron develops a little heat. Some of the energy of the magnetizing force is absorbed. The bar may actually change a little in length or volume, due to the rearrangement of the atoms.

This last effect, technically known as "magnetostriction," has recently been studied illuminatingly by Dr. McKeehan of the Bell Telephone Laboratories.*

As all students of radio now know, Mr. G. W. Elmen, of these same laboratories, invented some time ago the remarkable new alloy called "permalloy." This permalloy possesses what is called in physical terminology an extremely high magnetic "permeability." This permeability corresponds, roughly, to ease of magnetization. It is reasonably accurate to say that permalloy is more easily magnetized, other things being equal, than even the best pure iron. Before Mr. Elmen's invention, this was regarded as an impossibility, the current magnetic theories indicating that pure iron was itself a more easily magnetizable substance than any alloy which could be made from it. Accordingly, Mr. Elmen having seriously cracked the then-existing magnetic theory, Dr. McKeehan set out to discover the reason for this disaster and, if possible, to repair the theory.

The clue to this repair turned out to be in the magnetostriction of the permalloy, the change of length or volume which samples of permalloy disclose when magnetized or demagnetized. Experiments show that this change, in the case of permalloy, is very small. Accordingly, in line with the theory of the tiny atomic magnets which must be turned around during magnetization, Dr. McKeehan concludes that the combination of iron atoms and nickel atoms produces an atomic structure in which the iron atoms can be turned around more readily, with less change in the volume of the material, with less friction and interference during the turning and, accordingly, with the high "magnetic permeability."

Dr. McKeehan's work thus provides not only an explanation of some of the peculiar properties of permalloy, but also another group of facts supporting the modern magnetic theory as above described.

In case of a transformer in a radio amplifier, every alternation of the oscillating current must be accompanied by a reversal of the magnetic forces in the iron core. This means that a large proportion of the atoms of iron inside the core are turning active somersaults, one for each reversal of the electric current. This continual somersaulting is not to be done without difficulty. Friction occurs between the atoms. Energy is lost. This is the energy which appears as "core loss" in transformer discussions and which may act, if the current in-

* "A Physical Background for Permalloy," by L. W. McKeehan. *Bell Laboratories Record* (New York), volume 3, pages 105-107 (December, 1926). "Magnetostriction," by L. W. McKeehan. *Journal of the Franklin Institute* (Philadelphia), volume 202, pages 737-773 (December, 1926).

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volved is large, to heat up the core of the transformer.

In the case of transformer cores, the effort of the designer is to procure alloys of iron in which the back and forth somersaults of the atoms occur as easily as possible, so that the loss of energy on each alternation of the current will be a minimum. There exist, however, many electro-magnetic problems in which the object is just the reverse of this. For example, in devices that employ permanent magnets, a familiar instance being the ordinary radio headphone, the effort is to make the "somersaulting" of the atoms as difficult as possible, so that when a piece of iron is once magnetized it will remain in that condition as long as possible.

For this purpose, it is now customary to employ alloys of iron with the metal cobalt; these alloys have been found to retain the magnetism more successfully than other known materials. From the viewpoint of atomic theory, these alloys are believed to be so constituted that, when the atoms have once been turned mainly in a single direction they will not turn around again easily or under the action of ordinary forces.

It is obvious that this theory of the tiny atomic magnets in alloys of iron helps to explain many other magnetic properties of these alloys, as, for example, the tendency of iron to lose its magnetism when heated or when subjected to repeated mechanical vibration.

It is possible to knock much of the magnetism out of the magnet of a telephone receiver by dropping the receiver on the floor. What happens, we believe, is that the shock loosens some of the atoms sufficiently to make them turn a partial or complete somersault, getting out of the magnetic alignment to which they previously conformed. The effect is somewhat the same as would be the effect of a mild earthquake shock on the crowd of people watching the chairman on the platform. Undoubtedly many of the human atoms would turn around in other directions to see what the earthquake shock meant. The orientation—the human "magnetism"—of the crowd would be lost.

A "Radio Motor"

THE fact that small plates cut from crystals of quartz can be set into violent oscillation when subjected to the voltage alternations of radio currents is now familiar to everybody; this, indeed, is the fact which underlies the use of these so-called "piezo-electric" crystals to control the frequencies of transmitters or to produce the most accurate kinds of wavemeters.

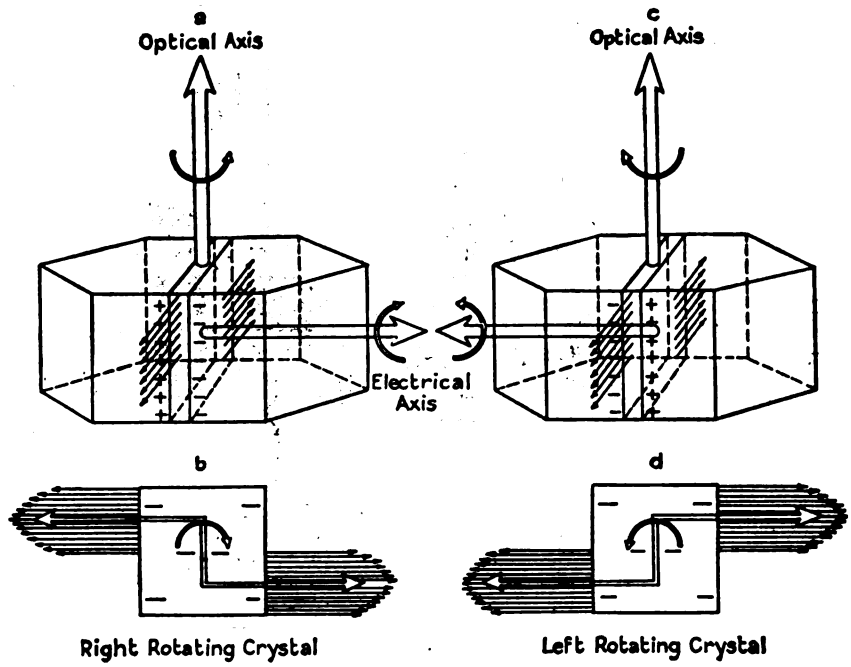
It is also well-known that sound waves can be produced by setting such crystals into vibration. The high-frequency, inaudible sound waves first investigated by Professor Langevin in France during the war and since studied so spectacularly by Professor R. W. Wood and Mr. Alfred Loomis, are produced in this way. One method of producing beams of under-water sound waves for determining the depth of the sea makes similar use of these vibrating quartz plates driven by audio-frequency currents.

At the meeting of the Institute of Radio Engineers in New York City on March 2, 1927, Professor W. G. Cady read a paper* by Dr. A. Meissner, the well-known engineer of the Telefunken Company, in Berlin, in which he described an interesting "radio motor" which can be constructed on the basis of this vibratory effect. A quartz plate, properly cut from a crystal and properly energized by a radio circuit, may be set into rapid rotation in its metal container or may even be inspired to jump entirely out of this container, so violent may be the motion imparted to it. If the quartz plate is mounted on a nearly frictionless spindle, like the mounting for the balance wheel of a watch, it will rotate rapidly around this axis and may even be persuaded to yield a very small amount of power, although not enough to cause the electric-motor industry any fear for its future business.

Dr. Meissner believes that the forces acting on a quartz plate so arranged are due to acoustic reactions between the plate and the air. The surfaces of the plate are vibrating rapidly back and forth, as the crystal shrinks and swells a trifle in the direction of the one of its crystal axes which corresponds to the particular frequency at which it is vibrating. This vibration of the quartz surface sets the adjacent air into a similar vibration. That is how the sound waves are sent out when a quartz crystal is used as a generator of sound.

The air is not, however, a perfectly elastic medium. At high frequencies of vibration the air molecules fail to respond perfectly to the rapid back-and-forth swings of the surface of the crystal. This produces, Dr. Meissner believes, actual currents of air blowing away from sides or corners of the crystal; indeed, these miniature winds can be demonstrated with light wind-vanes, sensitive flames and the like. It is also possible to show that the winds are a little off center on the crystal plate. Accordingly, they produce a twisting force which sets the crystal into rotation. The radio oscillations produce a vibration, the vibration produces winds, the winds turn the "radio motor."

(*Continued on page* 586)



From the Proceedings of the Institute of Radio Engineers

QUARTZ PLATES FOR THE RADIO MOTOR

By means of these diagrams, Dr. A. Meissner illustrated to the Institute of Radio Engineers how plates of quartz cut from natural quartz crystals may be set into rotation by being subjected to alternating electrostatic stresses. The forces which move these small "radio motors" are believed to be due to tiny winds created by the vibration of the quartz plates in the air, as is shown by the diagrams above.

* "Piezo-Electric Crystals at Radio Frequencies," by A. Meissner. To be published in the *Proceedings of the Institute of Radio Engineers* (New York). Cited from reprint distributed at the meeting of the Institute, March 2, 1927.

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★ PROGRAM FEATURES *for* THE MONTH

Here is POPULAR RADIO'S *selection of the "star" broadcast features that are scheduled as regular weekly events for the month beginning May 16—program numbers of outstanding merit that are selected on the basis of intrinsic worth, as well as upon their importance as determined by the large audiences reached by powerful single stations and by the chain stations that now cover the country. Every radio fan has—or should have—a receiver good enough to tune in on most of the features that are listed.*

(THE PROGRAMS GIVEN HERE ARE SCHEDULED ACCORDING TO EASTERN STANDARD TIME; FOR BROADCAST LISTENERS LIVING IN LOCALITIES THAT USE DAYLIGHT SAVING TIME, THE TIMES OF PERFORMANCE ARE AN HOUR LATER THAN EASTERN STANDARD TIME.)

Mondays

ROXY AND HIS GANG; 7.30 P. M.; *110-piece symphony orchestra, with soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WRC, WSB, WHAS, WSM.

Roxy, with the crowning achievement of all, broadcasting for one and one-half hours. Roxy exercises the talent of the musical staff of the world's greatest theatre. This great weekly festival always includes the world's largest organ, the world's largest theatre symphony and one of the country's largest broadcasting chains. Roxy's broadcasting takes the form of a series of musical surprises. Douglas Stanbury, a young Canadian tenor, is Roxy's star tenor soloist. He is the *fiancé* of Mlle. Maria Gambarelli.

HIRE'S HARVESTERS; 8.00 P. M.; *instrumentalists;* WEAF, WEEI, WGR, WLIT, WRC, WCAE, WTAM, KSD, WCCO.

This group is now engaging in another "musical tour of the world." Although musical tours have long ceased to be novel, Hire's Harvesters are able to attract and hold listeners.

WILLYS-OVERLAND SYMPHONY; 8.30 P. M.; *symphonic music and soloists;* WJZ.

Henry Hadley, with a "hand-picked" orchestra recruited from the ranks of the great New York Philharmonic Orchestra. This feature has recently been augmented by the addition of the Willys-Overland Mixed Quartet. This is essentially a music-lovers' feature, although it at times deals in such trifles as "No, No, Nanette" and "Tea for Two."

RECORD BOYS; 9.00 P. M.; *songs and humor;* WJZ, WBZ.

The funniest negro talk on the air. This is really an A-1 comedy program, provided by a trio of old-time performers who know how to merchandise songs. Al Bernard, Frank Kamplain and Sammy Stept are the performers.

A. AND P. GYPSIES; 9.00 P. M.; *classical and semi-classical music;* WEAF, WEEI, WJAR, WDAF, WRC, WCSH, WTAM, WLIT, WWJ, WCAE, WSAI.

A stimulating musical organization assisted by John Barnes Wells, lyric tenor. Mr. Wells (shown at the left) is not only a tenor of note, but an instructor and authority on singing. Harry Horlick is the director of the orchestra.

BARRERE LITTLE SYMPHONY; 9.00 P. M.; *ensemble; classical selections only;* WABC.

George Barrere, the director of this ensemble, is one of the greatest musicians appearing regularly on the air; he is the first flutist of the New York Symphony. He performs the seemingly impossible in playing the flute and conducting the orchestra at the same time. This organization is a real favorite with the musical enthusiasts of New York.

WBAL ENSEMBLE; 9.00 P. M.; *chamber music;* WBAL.

The WBAL Ensemble is a hand-picked musical organization, made up of wood-winds and strings, under the direction of Robert Iula, shown at the left.

RUUD LIGHT OPERA; 9.30 P. M.; *orchestra and soloists;* WJZ, KDKA, WBZ.

Erva Giles, soprano, and Frank Munn, tenor, are the stars of this feature. These brilliant performers are supported by the Ruud Light Opera Orchestra, under the capable directorship of Walter Henschen. The Ruud organization has been unusually successful in popularizing light opera material.

LIDO VENICE DANCE ORCHESTRA; 10.10 P. M.; *jazz music;* WEEI.

Jacques Renard takes his position somewhere among the good dance orchestra leaders of the country. He has been supplying music for this period for the last year, and it is said that his audience has grown to great size.

B. A. ROLFE'S DANCE ORCHESTRA; 11.00 P. M.; *jazz numbers;* WEAF.

B. A. Rolfe was one of the first orchestra leaders to leave the camp of wild syncopation and he is at present the leader of the movement for well-mannered and well-behaved jazz. Rolfe was at one time the leader of a classical ensemble.

WBAL DANCE ORCHESTRA; 11.00 P. M.; *dance music;* WBAL.

WBAL tries its hand at syncopation. Baltimore dances to this orchestra regularly.

CORNADA ORCHESTRA; 1.00 A. M.; *dance music;* KMOX.

KMOX stirs the midnight air with St. Louis' idea of a rousing good dance orchestra.

Tuesdays

DINNER CONCERT; 6.30 P. M.; *classical and semi-classical music;* WGY.

Middle New York's finest contribution to evening music—the dinner music supplied by the Hotel Ten Eyck Concert Ensemble.

WBAL DINNER MUSIC; 6.30 P. M.; *chamber music;* WBAL.

GEORGE OLSEN'S STROMBERG-CARLSON ORCHESTRA; 8.00 P. M.; *dance music;* WJZ, WBZ, KDKA, KYW.

George Olsen and a special orchestra that has been assembled to meet better the limitations of broadcasting. Olsen has signed a year's contract to broadcast exclusively for the Stromberg-Carlson Mfg. Corp.; he used to broadcast from the grill room of the Pennsylvania Hotel in New York.

EDISON ENSEMBLE; 8.00 P. M.; *classic and popular music;* WRNY.

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New!

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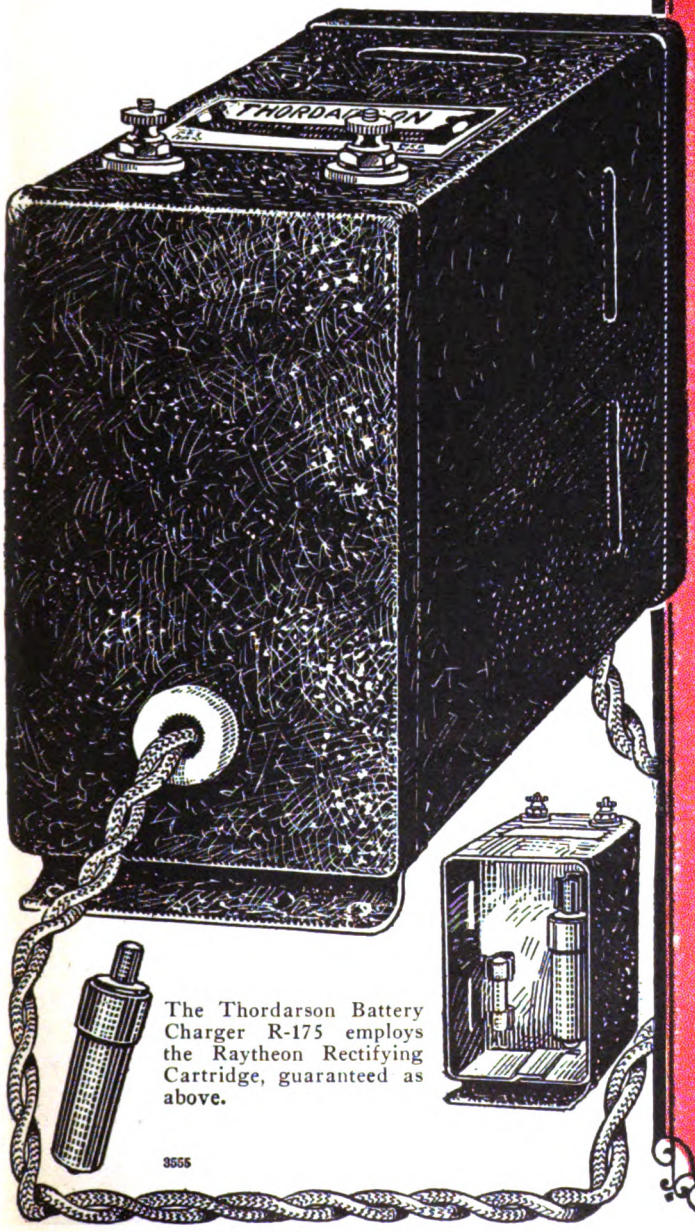

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GRAND OPERA PROGRAM; 9.00 P. M.; *soloists and instrumentalists;* WJZ, KDKA, KYW.
Genia Zielinska, soprano; Devora Nadworney, contralto; Guiseppi de Benedetto, tenor, and Nino Kuisi, basso; with the heavy stuff from the great operas. This is largely an Italian quartet and naturally takes its music very seriously.

EVEREADY HOUR; 9.00 P. M.; *varied program;* WEAF, WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI, WTAG, WRC, WGY, WHAS, WSM, WSB, WMC.

The Eveready Hour has in the last six months ascended to true greatness, both in program making and in execution; any fair critic of broadcasting will be forced to include it in the ten best features on the air. It is usually a program with a distinct trend in the direction of continuity. Virginia Rea is the coloratura soprano of this group.

EDUCATIONAL PROGRAM; 9.00 P. M.; *lectures;* WLWL.
One of a precious few real good educational programs, featuring professors of the various colleges and universities located within the bounds of New York City.

JUBILEE SINGERS; 9.00 P. M.; *female quartet;* WBAL.
Sob numbers for those who like them. They are very well sung, however.

SAM 'N' HENRY; 9.00 P. M.; *negro comedy;* WGN.
A consistently funny duet of darky songs and darky lingo.

MUNICIPAL BAND; 10.00 P. M.; *Baltimore City Band;* WBAL.
The pride of Baltimore exposes its musical wares to the fans of the United States. This band, under the direction of Nelson C. Kratz, is used for all official occasions in Baltimore.

BRIDGE INSTRUCTION; 10.00 P. M.; WEAF, WEEI, WCSH, WTAG, WJAR, WGR, WCAE, WTAM, WFI, WWJ, WSAI, WGN, WOC, WCCO, KSD, WRC, WGY.

A description of bridge as it is played by the patriarchs of the game. The plays are announced by Graham MacNamee.

DON AMAIZO; 10.00 P. M.; *violinist;* WJZ, KDKA, KYW, WCCO.

Cooking oil romanticism delivered by Col. C. T. Davis. Those who have patience enough to listen to the wordy and flowery descriptions of the exploits of Don Amaizo will be amply repaid by the violin selections. Although it is not generally known, the dashing Don Amaizo is none other than Godfrey Ludlow, shown at the left.

ARROWHEAD INN ORCHESTRA; 10.30 P. M.; *dance music;* WGBS, WIP.
One of New York's many dance orchestras played in a famous road-house at the gateway to Broadway.

PENNSYLVANIA GRILL; 10.30 P. M.; *dance music;* WJZ.
Roger Wolfe Kahn, precocious son of the renowned Otto, in what used to be George Olsen's shoes. However, young Mr. Kahn seems to be holding up to the traditions of the Pennsylvania grill room. This feature is an exceptionally reliable source of good dance music.

Wednesdays

DINNER CONCERT; 6.45 P. M.; *chamber music;* WSM.
A small ensemble with good talent and good intentions. Only the classics are played.

RADIO NATURE LEAGUE; 7.30 P. M.; *nature talks;* WBZ.

Thornton Burgess, and other naturalists, in lectures full of absorbing interest for those who love the open spaces.

STEINDAL STRING QUARTET; 7.30 P. M.; *semi-classical music;* KMOX.
A small organization with good talent devoting itself to the masters.

KATZ AND HIS KITTENS; 8.00 P. M.; *dance orchestra;* WQJ.
One jazz orchestra able to raise its head above the several million other orchestras in Chicago.

IODENT'S NO. 1 AND NO. 2; 8.30 P. M.; *the Mitchel Brothers, banjo and piano;* WJZ, WBZ, KDKA, KYW.

John and Bill Mitchel enter the crooning contest with good success. While these performers will never give music lovers musical indigestion, their act is bright and sparkling enough to interest the popular song fan.

DAVIS SAXOPHONE OCTETTE; 8.30 P. M.; *popular and classic music;* WEAF, WEEI, WJAR, WLIT, WRC, WCAE, WTAM, WSAI, WCSH.
Eight saxophones under the perfect control of Clyde Doerr, who opens his program with the spirited "Davisax" march.

REMINGTON BAND; 8.30 P. M.; *typical band selections;* WGY.

A big band from a little town broadcasting from one of the great American stations. This band is made up of the employees of the Remington Typewriter Co. at Ilion, N. Y.; its conductor is Edwin L. Daniels.

IPANA TROUBADOURS; 9.00 P. M.; *dance music;* WEAF, WEEI, WGR, WRC, WCAE, WWJ, WLIB, KSD, WCCO, WDAF, WGY.

Bombastic troubadour music and dance numbers molded into perfect shape under the guidance of Sam Lapin's baton.

MAXWELL HOUR; 9.00 P. M.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW, WHAS, WSB, WMC, WSM.
Great moments in music supplied by a famous orchestra and a famous director. Shilkret's Maxwell Ensemble has never won a blue ribbon simply because blue ribbons have never been offered to air performers.

RCA RADIOTRONS; 10.00 P. M.; *songs and comedy;* WJZ, WBZ, KDKA, WEBH.
A brilliant program built around the talent of the Shannon Quartet: Andy Sanella, saxophonist; Sammy Herman, xylophonist, and L. T. Priest, comedian. This is one of the best variety features on the air.

FISHER'S DANCE ORCHESTRA; 10.00 P. M.; *dance music;* KFI.
Ray Fisher is the big gun in dance music in the West, where Lopez is just a legend.

SMITH BROTHERS; 10.00 P. M.; *humorous songs;* WEAF, WTAG, WGR, WRC, WCAE, WWJ, WSAI, KSD, WOC, WCCO, WDAF.

The personified "Trade Marks" of a great cough-drop manufacturer, "Mark" and "Trade" sing foolish little ditties with a great deal of success. Their parts are taken by two Rutgers College students, "Scrappy" Lambert and Billy Hillpat.

HAGAN'S DANCE ORCHESTRA; 11.00 P. M.; *dance program;* WOR.
A newcomer whose stock has appreciated in value since the first week. Hagan has no style of his own, but he plays other styles remarkable well.

JADE ROOM DANCE ORCHESTRA; 11.00 P. M.; *dance music;* WTAM.
Emerson Gill, with an orchestra which is helping to make the "Sixth City" famous.

KFI MIDNIGHT FROLIC; 3.00 A. M.; *varied program;* KFI.
Big-time vaudeville circuits supply the talent for this stimulating hour of music.

Thursdays

PALAIS ROYAL ORCHESTRA; 6.00 P. M.; *dance music;* WEEI.
Boston's idea of a rousing good dance organization.

MEYER DAVIS ORCHESTRA; 7.00 P. M.; *dance music;* WGBS.
Davis is always mentioned along with Lopez, Olsen, and the rest of New York's best.

ORGAN RECITAL (Fred Weaver); 7.30 P. M.; *classical and semi-classical selections;* WBAL.
Just the kind of organ music that most people like to hear.

CONCERT ENSEMBLE; 7.35 P. M.; *chamber music;* WGN.
This is a rare thing in Chicago—good chamber music.

CHATEAU SOURIER CONCERT; 7.45 P. M.; *chamber music;* CNRM.
Chateau Sourier is Montreal's greatest hotel, and this concert is supplied by its dining-room ensemble.

WBAL ENSEMBLE; 7.45 P. M.; *chamber music;* WBAL.
Something you'd like to listen to after a hard day at the office.

CLICQUOT CLUB ESKIMOS; 9.00 P. M.; *banjo ensemble;* WEAF, WEEI, WCCO, WGN, WCAE, WGY, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ.

Harry Reser, with a snappy dance orchestra made up principally of banjoes. Each evening's entertainment is usually marked by some unique departure from conventional music-making.

FULLER ORCHESTRA; 9.30 P. M.; *popular music;* WGHP.
No. 2 on the list of Chicago dance orchestras.

GOODRICH SILVERTOWN ORCHESTRA AND SILVER MASKED TENOR; 10.00 P. M.; *popular music;* WEAF, WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WSAI, WCSH, WADC, WHAS, WSB, WSM, WMC.
The return to the air of the Goodrich Silvertown Cord Orchestra and the Silver Masked Tenor after playing a thirty-week engagement on the B. F. Keith vaudeville circuit.

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Fridays

HOTEL BRETTON HALL ORCHESTRA; 6.30 P. M.; *chamber music;* WOR.
An old standby of the one who prepares these little comments. Not perfect, just good.

KING EDWARD HOTEL ORCHESTRA; 6.35 P. M.; *chamber music;* CNRT.
Those residing in northern New York will do well to tune this in. Such good music is difficult to find.

MIXED QUARTET; 7.30 P. M.; *male voices;* WBAL.
Just a nice little quartet singing little ditties that quartets are always expected to sing.

HAPPINESS BOYS; 7.30 P. M.; *songs and jokes;* WEAF.

Billy Jones and Ernest Hare in a half-hour of foolishment and song. Although their humorous supply often becomes a bit "mossy," their songs are unfailingly fresh and original—and they enjoy their own act as genuinely as do their audiences.

GOLDMAN BAND; 8.00 P. M.; *wide range of selections;* WEAF, WEEI, WGR, WLIT, WRC, WCAE, WTAM, WWJ, WSAI, WOC, WCCO, WGY, KVOO, WFAA, WOAF, WLIB.

Edwin Goldman's famous symphony in brass is an outfit that is always worthy of a Red Seal record. Goldman's repertoire is usually one of wide variety, running all the way from brilliant modern marches to Tschaikowsky and Beethoven. Perhaps the best of the bands that are now broadcasting.

MARKEL'S SOCIETY ORCHESTRA; 8.00 P. M.; *dance music;* WJZ, WBZ, KDKA, KYW.
What New York's best society uses when it wants to dance. Markel's Society Orchestra means just that—nothing more and nothing less.

ROYAL HOUR; 8.30 P. M.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW.
Joe Green and his Royal Music Makers have been supplying Grade "A" music since chain broadcasting was a pup.

TRAYMORE CONCERT ORCHESTRA; 9.00 P. M.; *chamber music;* WPG.
One of the Atlantic City hotel ensembles fills a half-hour of WPG's time. This is the dining-room organization of one of the best hostelries.

LA FRANCE ORCHESTRA; 9.30 P. M.; *popular orchestral music;* WEAF, WGR, WLIT, WOC, WCAE, WTAM, WWJ, KSD, WDAF, WMAG.

Anna C. Byrne, with a group of 33rd-degree musicians, specializing in the classics and semi-classics. No small orchestra on the air has a more enviable record.

ARMCHAIR HOUR; 10.00 P. M.; *vocal and instrumental music;* WJZ, WBZ.

WJZ "fills in" with studio talent. Keith McLeod on the vibraphone, Godfrey Ludlow on the violin and a quartet made up of announcers supply the entertainment. Marley Sherris (at the left) is one of the performers before the Mike.

WHITTAL ANGLO-PERSIANS ORCHESTRA; 10.00 P. M.; *classical and semi-classical music;* WEAF, WEEI, WJAR, WTAG, WGR, WLIT, WTAM, WCAE, WWJ, WCCO, WDAF, KSD, WOC, WGN, WGY.

This ensemble comes dangerously close to measuring up to the highest standards. They have, since the inception of this feature, been an unfailing source of classical music, well chosen and well played. The organization is under the direction of Mr. Louis Katzman.

PENNSYLVANIA GRILL; 10.30 P. M.; *dance music;* WJZ.
One of two weekly "appearances" of Roger Kahn and his very popular jazz band. Mr. Kahn has many dance orchestras operating under his name, but this is the only one he directs personally.

DANCE ORCHESTRA; 11.00 P. M.; *dance music;* KDKA.

Saturdays

JACQUES RENARD'S ORCHESTRA; 6.45 P. M.; *dance music;* WEEI.
Rip-snorting dance music from a young French director with American ideas. He's very popular up Boston way.

ARCADIA BALL ROOM ORCHESTRA; 7.45 P. M.; *dance music;* WGBS.
One of the many, many good dance orchestras playing regularly for New York broadcasters.

HOTEL CHELSEA CONCERT; 9.30 P. M.; WPG.
Good enough for one of the best hotels in Atlantic City.

BENJAMIN FRANKLIN ORCHESTRA; 10.05 P. M.; *chamber music;* WIP.
One of a very few sources of good music in the Quaker City.

ARCADIA DANCE ORCHESTRA; 12.00 P. M.; *dance music;* KMOX.
St. Louis makes a bid for midnight popularity.

COLORADO ORCHESTRA; 12.30 P. M.; *dance music;* KOA.
KOA enters the midnight competition for listeners to dance music.

Sundays

ROXY SUNDAY PROGRAM; 2.00 P. M.; *vocal and instrumental numbers;* WJZ, WBZ, WBZA, KYW, WRC.
Roxy in a real surprise grab-bag program; even the studio staff is not informed as to the nature of the program until the last minute. As an index of the character of this program, it might be said that Roxy recently strolled into the studio with Carrie Jacobs Bond, Evelyn Herbert and Margaret Anglin.

BEDFORD Y.M.C.A. MEN'S CONFERENCE; 4.00 P. M.; *Dr. S. Parkes Cadman;* WEAF, WEEI, WCSH, WTAG, WCAE, WSAI.

Popular philosophy for those who like their Sunday religion in light doses. Dr. S. Parkes Cadman is perhaps the best known divine in the country, due largely to his broadcasting activities and to his widely syndicated newspaper articles.

CROSLEY RADIO FEATURE (alternate weeks); 5.30 P. M.; *varied program;* WEAF, WEEI, WJAR, WTAG, WGN, WFI, WRC, WCSH, WCAE, WTAM, WWJ, WSAI, KSD, WDAF, WHAS, WSM, WSB, WMC, WGY.
The Crosley Radio Corporation makes its contribution to broadcasting with a varied musical program. After a day of heavy preaching, it comes as welcomed relief.

PARK V. HOGAN ORGAN RECITAL; 7.00 P. M.; *organ and vocal;* WJZ.
For over three years Park Hogan has been playing for New York's greatest station. Isn't that sufficient endorsement?

THE CAPITOL GRAND ORCHESTRA (and Major Bowes' family); 7.20 P. M.; *symphonic music and soloists;* WEAF, WEEI, KSD, WRC, WWJ, WJAR, WCAE, WTAG, WHAS, WSB, WSM, WMC.

As the publicity man writes, "A galaxy of stars," in a two-hour program full of solid entertainment. This organization, obviously to meet the new Roxy competition, has increased the strength of its grand orchestra by fourteen men, bringing the total up to ninety-four. Thus, it takes its place as the second largest symphony orchestra on the air. The Capitol Grand Orchestra and the Baby Grand Studio Orchestra are under the direction of David Mendoza, a young Spaniard, not yet in his thirties. Mendoza was at one time the first fiddle in the orchestra under the Roxy régime. The impresario is Major Edwin Bowes.

DELLA ROBBIA CONCERT; 7.45 P. M.; *chamber music and solos;* WOR.
A nice little Sunday evening concert from a nice little broadcasting station and a nice little hotel. This concert offers great relief to an afternoon filled with all sorts of hymn tunes and exhortations.

COOK'S TOURS; 8.30 P. M.; *travelogue with music;* WJZ.
Although one of the oldest commercial features on the air, Cook's travelogues are still immensely popular with the radio audience. It is well-deserved popularity, however, for these travelogues, with their musical background, have been consistently good.

AMBASSADOR CONCERT; 9.10 P. M.; *chamber music;* WPG.
A great Atlantic City hotel gets a little well-deserved publicity.

ATWATER KENT HOUR; 9.15 P. M.; *star soloists;* WEAF, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ, KSD, WRC, WSAI, WGY, WHAS, WSB, WMC.

The moguls of operatic music in an ambitious effort to produce the outstanding event in weekly broadcasting. Except on rare occasions, vocal numbers are solos. The conductor of the orchestra is Mr. Niccolai Berezowsky.

COLLIER HOUR; 9.30 P. M.; *variety program;* WJZ, KYW, WBZ, KDKA.
The Collier Hour involves good music, story-telling and educational discussions. All of this is ingeniously arranged and presented with amazingly good showmanship and continuity.

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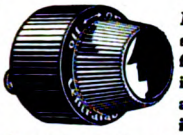
centralab Station SelectoR



BIGGEST *Dollar's Worth in Radio.* Tunes out short wave interference, increasing selectivity of any set (not using loop) on stations close to local, except *same* wave length stations. *Not* a wave trap. *No* adjustments. At dealer's or send us dollar bill. *Money-Back Guarantee. Satisfaction guaranteed.*

centralab Modu PluG

GIVES old receivers the improved tone volume control of latest, best sets. Replaces present speaker plug. Tune in with dials. Then modulate *to any degree* on Modu Plug alone (between speaker and set). Reduces interfering noises. Attaches without tools. Nothing else like it. Cord or Jack Type, $2.50 at dealers', or mailed C. O. D.

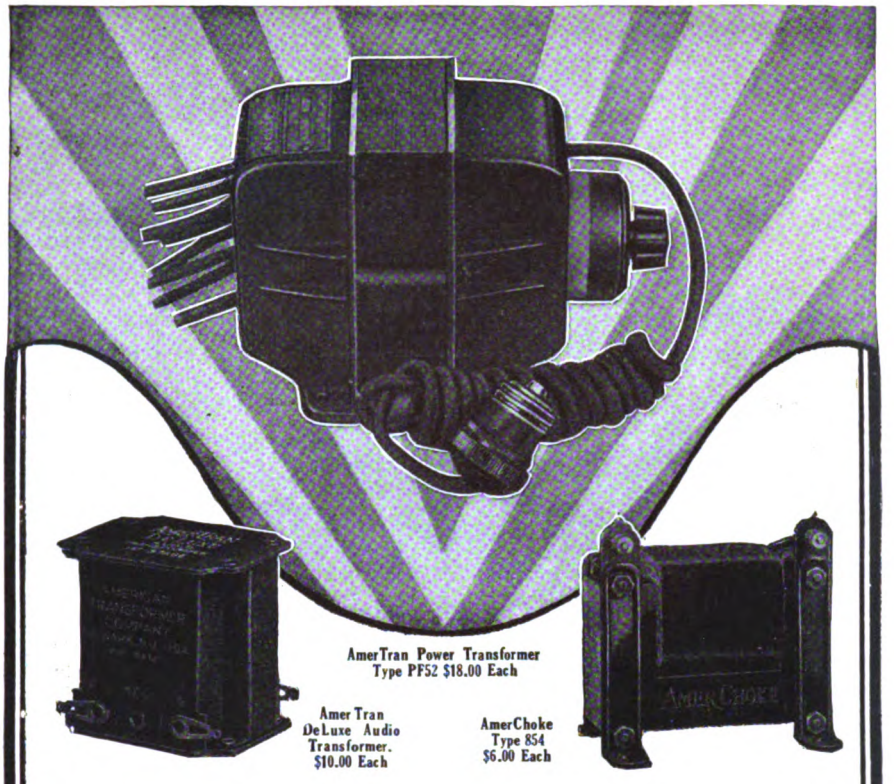
Parts manufacturers for 69 makers of leading standard sets.

Central Radio Laboratories
17 Keefe Ave. Milwaukee, Wis.

Centralab

Statement of the ownership, management, circulation, etc., required by the act of Congress of August 24, 1912, of POPULAR RADIO, published monthly at New York, N. Y., for April 1, 1927, State of New York, County of New York.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Douglas H. Cooke, who, having been duly sworn according to law, deposes and says that he is the Publisher of the POPULAR RADIO and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Douglas H. Cooke, 627 West 43d Street, New York City, N. Y.; Editor, Kendall Banning, 627 West 43d Street, New York City, N. Y.; Managing Editor, Kendall Banning, 627 West 43d Street, New York City, N. Y.; Business Manager, E. A. Harm, 627 West 43d Street, New York City, N. Y. 2. That the owner is: POPULAR RADIO, Inc., whose stockholders are: Douglas H. Cooke, 627 W. 43d Street, New York City; Kendall Banning, 627 West 43d Street, New York City; Laurence M. Cockaday, 627 West 43d Street, New York City; Theodora W. Cooke, 59 Beechmont Drive, New Rochelle, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: NONE. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. Douglas H. Cooke, Publisher. Sworn to and subscribed before me this 1st day of April, 1927. Sadie M. Nilan, Notary Public, Queens County. (My commission expires March 30, 1928.)



BETTER RADIO NEEDS THESE QUALITY AMERTRAN UNITS

You wouldn't consider a cheaply built engine in a $3,000 car——

Then why spend money for a good loudspeaker and good tubes for use in the new set you are building and put into it poorly designed, inefficient audio transformers?

AmerTran DeLuxe transformers are so perfected that they cause tubes to amplify with all their natural fullness. Lesser transformers cannot equal the AmerTran DeLuxe for dependable volume and tone quality. Properly installed, they result in uniform reception over the entire useful audible range.

There is no question about the AmerTran DeLuxe. Time and again it has proved to the satisfaction of engineers and laboratory workers that it is the truly outstanding audio transformer. Finest results with modern speakers and tubes are easily obtainable, and comparison will convince you that the AmerTran DeLuxe sets an entirely new standard of audio amplification.

Battery Elimination

The AmerTran Power Transformer Type PF52, AmerChoke Type 854, and the AmerTran Resistor Type 400 are recommended for the construction of a highly efficient high voltage plate supply. Through slight changes in your set, you may replace all batteries with an unexcelled source of reliable power. Write for information on building this apparatus—also free booklet, "Improving the Audio Amplifier."

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Schedules of Dinner-Hour and Dance Programs of Special Note

★ Programs of Dinner-Hour Music

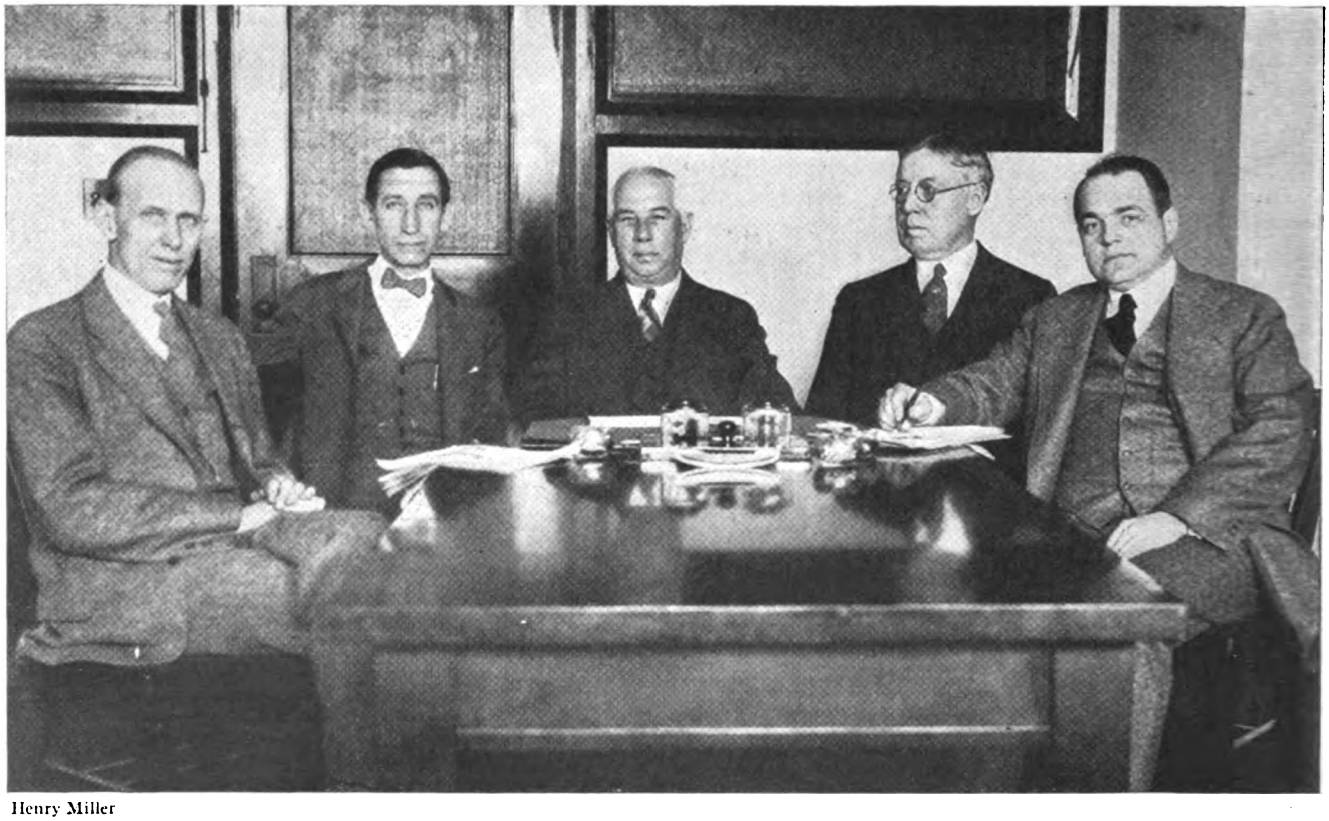
(Eastern Standard Time)

FEATURE	STATION	TIME
Palmer House Victorians	WEBH	7:15 P. M.; *daily except Sundays.*
Hotel Andrew Jackson Concert	WSM	7:15 P. M.; *Tuesdays;* 6:45 P. M.; *Wednesdays and Thursdays.*
Neopolitans	WTAM	6:00 P. M.; *Wednesdays and Thursdays.*
Emerson Gill's Orchestra	WTAM	6:00 P. M.; *Fridays.*
Bem's Little Symphony	KGO	9:00 P. M.; *daily except Saturdays.*
Kats and His Kittens	WQJ	8:00 P. M.; *daily except Sundays and Mondays.*
Hotel Tuller Concert	WGHP	7:00 P. M.; *daily except Sundays.*
WBAL Dinner Concert	WBAL	6:30 P. M.; *Mondays, Tuesdays, Thursdays and Fridays.*
Joe Rine's Orchestra	WEEI	6:05 P. M.; *Mondays, Wednesdays and Thursdays.*
Jack Renard's Orchestra	WEEI	6:45 P. M.; *Saturdays.*
Mack's Collegians	KFI	9:30 P. M.; *Saturdays.*
Ray Fisher's Orchestra	KFI	10:00 P. M.; *Wednesdays.*
Concerts from Atlantic City Hotels	WPG	7:25 P. M.; *daily except Sundays.*
Special Dinner Programs	WBZ	7:00 P. M.; *daily.*
KDKA Little Symphony	KDKA	6:00 P. M.; *Tuesdays, Thursdays.*
Coronado Orchestra	KMOX	7:00 P. M.; *Sundays.*
Organ Recital	KMOX	7:00 P. M.; *daily except Sundays.*
Drake Concert	WLIB	8:00 P. M.; *Tuesdays, Thursdays and Saturdays.*
Drake Concert	WGN	7:35 P. M.; *daily except Sundays.*
Brown Palace Orchestra	KOA	8:30 P. M.; *daily except Thursdays.*
Benjamin Franklin Orchestra	WIP	6:10 P. M.; *Tuesdays, Wednesdays, Thursdays and Saturdays.*
McDonald's Orchestra	WIP	6:10 P. M.; *Mondays and Fridays.*
Bretton Hall String Quartet	WOR	6:30 P. M.; *Tuesdays and Fridays.*
Dinner Concert	WWJ	6:00 P. M.; *except Saturdays and Sundays.*
Jack Jacobs Orchestra	WOR	6:15 P. M.; *Mondays, Wednesdays, Thursdays and Saturdays.*
Twilight Musical	WAIU	7:00 P. M.; *Mondays, Tuesdays and Wednesdays.*

★ Programs of Dance Music

(Eastern Standard Time)

FEATURE	STATION	TIME
Colorado Orchestra	KOA	12:15 P. M.; *Saturdays.*
Packard Six Orchestra	KFI	1:00 A. M.; *Monday mornings.*
Coronado Orchestra	KMOX	1:00 A. M.; *Mondays, Tuesdays, Wednesdays, Fridays, Saturdays.*
Arrowhead Inn Dance Orchestra	WGBS, WIP	10:30 P. M.; *Tuesdays and Saturdays.*
McDonald Recording Orchestra	WGBS, WIP	10:30 P. M.; *Thursdays.*
Van Horn Dance Hour	WPG	10:30 P. M.; *Fridays.*
Casino Dance Orchestra	WPG	11:30 P. M.; *Saturdays and Mondays.*
Silver Slipper Orchestra	WPG	11:30 P. M.; *Tuesdays.*
Golden Pheasant Orchestra	WTAM	10:15 P. M.; *Sundays.*
Emerson Gill Orchestra	WTAM	10:00 P. M.; *Mondays and Wednesdays.*
Far East Orchestra	WTAM	11:00 P. M.; *Thursdays.*
Jade Room Orchestra	WTAM	11:30 P. M.; *Fridays.*
Simovar Orchestra	WENR	1:00 A. M.; *Thursday, Friday and Saturday mornings.*
Midshipmen Orchestra	KGO	12:30 P. M.; *Thursdays.*
Kats and His Kittens	WQJ	11:00 P. M.; *Saturdays, Tuesdays, Wednesdays, Thursdays and Fridays.*
WBAL Dance Orchestra	WBAL	11:00 P. M.; *Mondays, Tuesdays, Thursdays and Fridays.*
Renard's Orchestra	WEEI	10:05 P. M.; *Mondays.*
Joe Rine's Orchestra	WEEI	10:05 P. M.; *Wednesdays.*
Nighthawks	WBBM	1:00 A. M.; *Mondays;* 12:00 P. M.; *Tuesdays and Thursdays.*
Vincent Carr Orchestra	WIP	10:05 P. M.; *Saturdays.*
Vanderbilt Dance Orchestra	WOR	11:35 P. M.; *Tuesday.*
Cass Hogan's Orchestra	WOR	11:00 P. M.; *Wednesdays and Saturdays.*
Fletcher Henderson's Orchestra	WOR	11:00 P. M.; *Fridays.*
Kentucky Serenaders	KYW	11:30 P. M.; *Saturdays.*
Roger Kahn's Orchestra	WJZ	10:30 P. M.; *Tuesdays.*
B. A. Rolfe's Orchestra	WEAF	11:00 P. M.; *Mondays.*
Goodrich Zippers	WEAF	10:00 P. M.; *Thursdays.*
Johnny Johnstone's Orchestra	WJZ	10:30 P. M.; *Thursdays;* 10:50 P. M.; *Saturdays.*



Henry Miller

The First Full Session of the New Radio Commission of the U. S. Department of Commerce

The arrival from abroad of Rear Admiral W. H. G. Bullard, several weeks after his appointment as Chairman, did not halt the work of this body, which proceeded to its task of bringing order out of the ethereal chaos with commendable promptness and efficiency, under temporary leadership. The members shown above, from left to right, are Henry A. Bellows, Eugene O. Sykes, W. H. G. Bullard, John F. Dillon and Orestes H. Caldwell.

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Experts in the POPULAR RADIO *Laboratory with measuring apparatus arranged for loudspeaker tests.*

HOW THE POPULAR RADIO LABORATORY HELPS YOU TO BUY GOOD LOUDSPEAKERS

A CONFUSING number of factors enter into the intelligent choice of a loudspeaker, and the layman, unless he is provided with the rare natural gift of a hypercritical ear and an innate "engineering sense," runs the risk of making a selection that will eventually prove unsatisfactory. The speaker of his choice may have sounded well in the dealer's store; it may have been well and artistically made, but he failed to properly judge the factors of the case. Some speakers, for instance, sound better on certain receivers; receivers that have electrical characteristics matching the characteristics of speakers of certain types.

What is the impedance of the speaker you have purchased or intend to purchase? Does it match the output impedance of the vacuum tube used? What is the resonance curve? Does it respond to the lower frequencies as well as the high ones? Will it, after a month or so of constant use, show a tendency to chatter on the crescendos? Is the parchment too hygroscopic? Does the speaker create extraneous noises that are believed, wrongly, to originate in the receiver with which it is used?

These are some of the many important questions that the POPULAR RADIO Laboratory answers for those who purchase loudspeakers advertised in its columns. Testing a speaker involves something more than merely listening to it. Days or even weeks may be required to properly determine whether or not a loudspeaker meets the high standards set by the engineering staff of POPULAR RADIO. Consequently, speakers approved by the Laboratory and advertised in the columns of the magazine may be purchased with the assurance of satisfactory performance, affording both the proper volume and a high degree of quality.

This is but one of the many services that POPULAR RADIO extends to its readers. As far as possible, it guarantees the purchasers of apparatus advertised in its columns against disappointment and loss. For over three years it has given of its time, money and resources, that its readers could buy with confidence and safety.

A list of tested and approved loudspeakers may be had by addressing a stamped, self-addressed envelope to the Service Department, 627 West 43rd Street, New York City.

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The "Secrets" of the Hypnotist by Radio

(*Continued from page 529*)

tist tells him to do or to believe.

To produce the after effects of post-hypnotic suggestion the hypnotist simply impresses on the mind of the subject some order to be carried out later on. He may say, for example, "in fifteen minutes you will go out to the news-stand and buy a copy of POPULAR RADIO."

Sure enough, when the allotted time has passed, the subject, who has been awakened in the meantime, will take his hat and depart on the errand mentioned, usually not quite knowing why he does so but feeling an irresistable impulse to the act.

This makes the feat of radio hypnotism very simple. The hypnotist needs merely to say to his subject, already hypnotized some hours ahead of the experiment:

"At eight o'clock tonight I shall speak to you over the radio and say 'sleep'; you will then instantly pass into a hypnotic sleep from which you will awake ten minutes later."

At the appointed hour the word "sleep" is spoken and the post-hypnotic suggestion takes its course. The magic word need not be "sleep"; it can be "buttons" or "abacadabra" or anything. All that is necessary is some signal for which the path has already been prepared by the previous hypnotic suggestion. Even that previous suggestion is unnecessary if the hypnotist and the subject are accustomed to working together. I know a hypnotist who needs merely to wave his hand at one of his subjects in order to send that subject into the hypnotic sleep. One word, in person, by telephone or by radio, would be equally efficacious.

The feat of Mr. Fitzgibbons involves, therefore, facts already quite well-known to experts on hypnotism. Nor is this expertness something which only Yogis or Mahatmas possess. Any physician or physiologist, acquainted with the workings of the human body, can learn the trick of hypnotism in a dozen hours. He may not qualify so soon in understanding the psychological meanings of hypnotic reactions; indeed, there are many of these reactions which are still not understood by anybody; but the mere performance of the hypnotic act is a secret soon grasped and easily practiced. Centuries ago, when the phenomena of hypnotism were first discovered by the famous French charlatan, Mesmer, from whose name "mesmerism" comes, they were believed to be related to dark secrets of "animal magnetism." That delusion is long dispelled. We now know that hypnotism merely reflects some little-used, but quite normal, powers of the human mind.

These powers are in the mind of the subject, not the mind of the hypnotist.

The thinking part of the human brain consists of about nine billion little gray cells, forming the so-called gray matter which is spread in a layer about one-sixth of an inch thick over about one and one-half square feet of the brain's outer surface. Connecting these gray cells with one another are billions of tiny separate fibers, like telegraph wires. These form the inner, white part of the brain. Thinking consists, in some way not yet completely understood, of the passage of messages back and forth from some gray cell to other ones. Sense impulses, like things seen by the eyes, are sent into the gray cells over the nerves; thus the process of thinking is started.

Although the explanation of hypnotism in terms of these thinking gray cells in the brain is still far from complete, it is possible to say that it consists of some sort of a block against the kind of thinking which ordinarily corrects mistakes and keeps us from doing ridiculous things. Were I to tell you, for example, that you are alone in the middle of the Atlantic Ocean and must instantly swim for shore, you refuse to get excited or to begin swimming. You can look around you and see for yourself that you are not in the middle of the Atlantic or of any ocean. Your own thinking corrects the mistake which I tried to tell you. It tells you, instead, that I am a liar.

To the hypnotized subject this kind of correction of what he is told by the hypnotist becomes impossible.

By some block of the white-fiber telegraph wires connecting his gray cells, he is prevented from doing any such corrective thinking at all. He is forced to think only what the hypnotist tells him. This is what is called "suggestion" and it is by no means confined to hypnosis. When someone works up a mob to the point of fury and unreason; when an orator sways his audience to believe (temporarily at least) something which they will presently reject; when some emergency like a fire or earthquake rouses individuals to acts of daring from which they would ordinarily shrink and which they may forget a few moments later—all those are instances of a mental condition like that which the hypnotist produces.

When any speaker over the radio is impressive enough to persuade you of something, he has really been practicing on you a kind of "radio hypnotism."

Without your consent, no one can practice more.

There are still many marvels which prevent our full understanding of hypnotism, but there are neither marvels nor dangers in the carriage of the hypnotizing stimulus by radio.

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Write us before you build

BEFORE you build, get our prices on the parts you are planning to use.

We handle only brand new apparatus—standard makes that are fully guaranteed. QUANTITY sale of QUALITY parts explains our low prices. Compare with others and see why thousands of fans look to us as radio headquarters.

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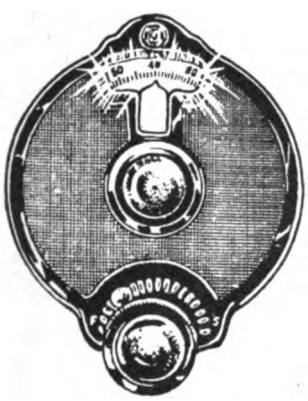


NEW LIGHT

on Fine Tuning

The Illuminated Dial

National Velvet-Vernier

Type C

More widely used in carefully engineered sets than ever before. Its brilliant, indirectly-lighted scale, lasting beauty, variable-ratio of 6-1 to 20-1, and ease of attachment are responsible for its deserved popularity SPECIFIED for the SC-II.

Send for Bulletin 116 L-6

NATIONAL COMPANY INC.

W. A. READY, Pres. Cambridge, Mass.

Be Sure You Get the Genuine

NATIONAL

RADIO PRODUCTS

How to Assemble the RGS Receiver

(*Continued from page 548*)

the set-screw on the rotor of condenser E and adjust the tuning condensers till the station is tuned in best. When this is done, tighten the set-screws on the rotors of all the condensers.

You will now find that any station may be tuned in by adjusting the condenser dials. The setting of the vernier knob, G, is not critical, as it is set directly to the dot on the panel in most cases, but maximum tuning efficiency may be obtained by a slight readjustment of this knob.

When first put into operation, the detector valve is apt to make the set noisy and may sometimes produce a howl. A slight readjustment of either the battery or volume knobs, or both, will usually eliminate noises. If the volume control is turned too far in a clockwise direction, a choking noise will result; this can be eliminated by turning the knob back slightly in a counter-clockwise direction.

The antenna knob serves to increase or decrease the electrical length of the antenna. The two-turn setting is at the "9 o'clock" position; the 32-turn setting is at the "3 o'clock" position.

Shortening the electrical length of the antenna gives greater selectivity and better distance at the short waves, but less distance at the long waves.

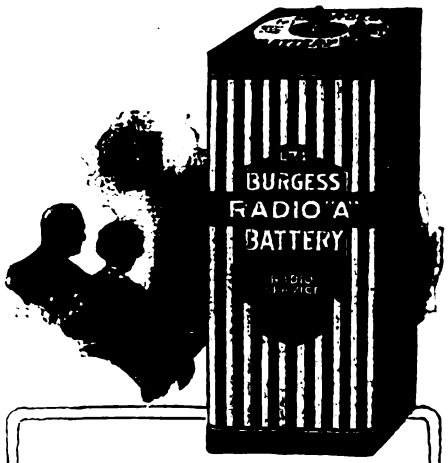
Increasing the electrical length of the antenna broadens the tuning and decreases the distance at short waves, but increases the distance at long waves. Any adjustment made in the electrical length of the antenna requires a slight readjustment of the first tuning condenser, D.

When tuning in lower wavelength stations, better results will be obtained if the vernier knob is adjusted to the left of the "12 o'clock" position, while on the higher wavelength stations better results will be obtained if the knob pointer is adjusted to the right of the "12 o'clock" position. At every wavelength in between there is a "best" adjustment, but this adjustment is not critical.

For best results on loud local stations, reduce the electrical length of the antenna and increase the volume control. These adjustments decrease the input without reducing volume and prevent overloading the detector valve. Any decrease in volume through cutting down the antenna length is compensated for by increasing the volume control.

A little practice with the controls will show you the settings that give the best results. Do not be too impatient the first time you try to tune in. Log all your local stations first and then you can determine the approximate settings to bring in the distant stations.

ASK . . ANY . . RADIO . . ENGINEER



This is the Burgess Radio "A" Battery

A SPECIALLY designed "A" battery for radio service. There is nothing like it in its field.

Proportioned to permit ease of handling and convenience of cabinet assembly and storage, you may expect this new Burgess creation to give you the length of service and dependability under all conditions for which all products of Burgess are noted.

If you are using the ordinary type of No. 6 "A" battery, we suggest that you learn for yourself from the Burgess Radio "A" the measure of service you have a right to expect.

Ask Any Radio Engineer

BURGESS BATTERY COMPANY

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BURGESS RADIO BATTERIES

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28 Leading Radio Engineers Specify
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Write for illustrated literature describing Hammarlund Precision Products for all of the popular circuits.
Ask us for a list of the latest models of receivers for which Hammarlund Products are officially specified

QUALITY DONGAN PRODUCTS

Your Source of Supply

Manufacturers find the newest approved features—in Audio transformers, B Power and Power Amplifier transformers and chokes—designed by Dongan, builders of radio parts, exclusively.

This is the season to secure the maximum service from our engineering staff.

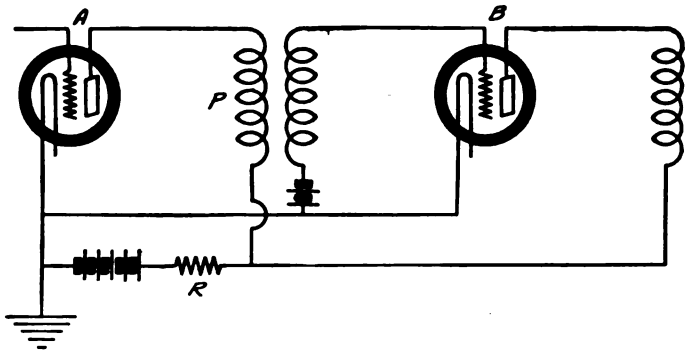
Complete information on Power Units for the new 350-400 MA Tubes. Several types, mounted or unmounted.

DONGAN ELECTRIC MANUFACTURING COMPANY
2983-3001 Franklyn St. Detroit, Mich.

TRANSFORMERS of MERIT for FIFTEEN YEARS

"Squeals"

(*Continued from page 532*)



YOUR BATTERIES MAY CAUSE HOWLING

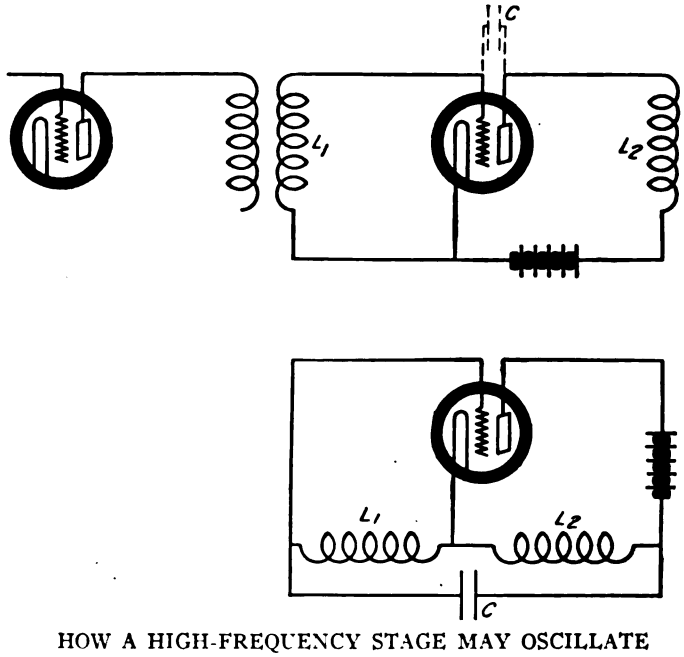
FIGURE 6: *This diagram shows how resistance in "B" batteries will tend to produce coupling between the two tube circuits, A and B. The resistance, R, which may be the resistance of the batteries, is included in the plate circuit of both valves, A and B, and any variation in the current from one will produce a drop across the resistance, R, and thus cause a varying voltage across the other valve-plate circuit. This may cause unwanted oscillations.*

ductance, adding resistance in the grid or plate circuit, using reversed inductive feedback, or by using neutralizing capacities.

The first two methods tend to reduce the amount of amplification obtainable. The most common method is the use of neutralizing capacities. In addition, it is necessary to prevent coupling between the radio-frequency transformers, such as by placing them so that no mutual inductance exists between them, by using some form of "Figure 8" or toroidal coils (Figure 2), which have localized fields or by shielding the coils electrostatically from one another. It is also necessary that the grid and plate leads and the connections in the high-frequency circuits be kept short and well separated from the other leads and the current carrying parts of the apparatus to which they are not connected.

Some form of feedback is always responsible for singing in the audio-frequency section of a receiver. It may be electrostatic, electromagnetic, mechanical or due to coupling through a resistance common to several tube circuits.

The arrangement of the parts in the input and output circuits so as to allow but little capacity between them, and the reduction of the grid and plate leads to the shortest lengths possible, will reduce electrostatic coupling. The designations on audio-frequency transformers as provided by the manufacturer should be followed in making connections, as this has an important bearing on the prevention



HOW A HIGH-FREQUENCY STAGE MAY OSCILLATE

FIGURE 7: *The capacity between the grid and plate of the vacuum valve used as a high-frequency amplifier is indicated at C. A rearrangement of this diagram has been made below showing that this circuit is, in effect, an oscillating circuit with a grid and a plate coil coupled through this capacity, C. That is the reason why high-frequency amplifiers oscillate unless they are neutralized or stabilized in some other manner.*

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of interstage coupling. It is always a wise policy to ground the transformer cores. In amplifiers intended for high amplification, it is generally necessary to enclose one or more stages in a metal shield.

Stray fields of transformers or retardation coil may provide coupling which will induce voltages in phase with the input voltages and thus cause singing. This may be prevented by using closed core coils, adjacent coils being placed at right angles to each other so that coupling between them is reduced to a minimum.

Where grid or plate voltages for more than one stage are obtained from the drop of potential across a resistance, the resistance should be shunted by a large capacity by-pass condenser. The same applies to batteries used to supply more than one stage with grid or plate potentials. In each case the condenser should be connected so as to provide a low impedance path to ground at the low potential end of the grid and plate circuits. The effect of a resistance common to more than one plate circuit is explained in Figure 6.

A general idea of the points to follow in arranging and wiring a receiver so as to make it howl-proof is given in Figure 3.

Singing from mechanical feedback may result when the vibration of the loudspeaker sets up a mechanical vibration of the tube elements, which commonly starts at the detector tube, causing a periodic variation of its plate current, which is amplified and reproduced in the loudspeaker. A repetition of this cycle continues until a sustained howl is produced, its tone being resonant to the mechanical period of vibration of the tube elements. The easiest applied remedy is to place as much distance as possible between the loudspeaker and the set; or, when the speaker is of the horn type, merely rotating it so as to direct its output away from the set will often eliminate the howling.

Should all these measures fail or if it is not desirable to change the position of the loudspeaker, the detector tube, and often the amplifier tubes also, should be equipped with vibration-proof sockets.

A receiving set free of all internal causes of squeals will be capable of accomplishing the utmost from a quality standpoint, within its circuit and apparatus limitations, but the external sources of squeals will still exist for some time. To obtain the minimum amount of disturbance it will be necessary to use discrimination in selecting stations for entertainment. Adjustments can be made that reduce the volume received from nearby high-power stations to a level that is ample and at the same time reduce the level of interfering transmitting and receiving stations to practical inaudibility.

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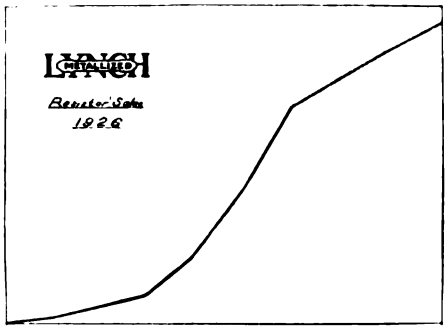

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LYNCH METALLIZED TRANSFORMED RESISTORS

What's New in Radio

(*Continued from page* 558)

receiver; the volume of reproduction may be regulated as desired by means of the third knob.

In addition to the simple installation and operation requirements of this set, there is an additional advantage in the fact that the receiver requires absolutely no upkeep attention. There are no batteries, chargers or electrolytic rectifiers to require the addition of water from time to time. Nor is there anything that requires further adjustment. So far as the owner of the receiver is concerned he will never have occasion to even raise the cover of the receiver until such time as a vacuum valve may wear out. But even this should not occur until the receiver has been in operation at least 1,000 hours, and probably not until after several thousand hours.

The instrument presents a beautiful appearance. It is entirely enclosed in a sturdy walnut cabinet of the table-mounting type which is 30 inches long, 11 inches high and 17 inches deep. This is finished in warm brown tones with an attractive arrangement of panels and borders for variety. The small panel which carries the tuning controls is of metal, finished to match the rest of the cabinet. It is placed in the center of the front wall of the cabinet but is recessed a distance of about one inch, thus breaking up the monotony of the large front surface. The calibrated tuning scales are stamped directly on this metal panel and the pointers on the two tuning knobs revolve over these scales.

This receiver may be placed on any convenient table, or may be used with a special stand to match the receiver which is put out by the manufacturer. The top of the cabinet is hinged at the back and raises up to disclose the interior of the receiver. It will be noticed that the radio unit itself is built up on a large composition sub-panel. This accommodates five of the vacuum valves or tubes, and the other parts of the receiver with the exception of the three tuning condensers which are mounted on a heavy metal sub-panel, that is parallel with, and just behind, the front control panel. The use of this metal panel for the mounting of the condensers helps to maintain their rigidity, and permits the coupling together of two of the condensers for operation by a single control.

The power supply equipment and the power amplifier valve are mounted on a separate composition sub-panel at the left-hand end of the interior of the cabinet. The power-pack and the receiver proper are therefore entirely separate units, but are inclosed in the same cabinet.

Shielding of the power-pack is provided by the metal cases which inclose its component parts. Shielding is also provided for the coils in the receiver proper, in the form of large, burnished copper "cans" which inclose the individual coils.

The receiver makes use of five vacuum valves, but the output of the receiver proper goes to the large power-amplifier valve which is located in the power-pack. In all, therefore, the receiver is a six-tube affair. The five valves in the receiver unit are of the McCullough AC type. These are special vacuum valves, so designed as to operate with an alternating-current filament supply, instead of the direct-current supply required by ordinary valves. These five tubes are used to provide two stages of high-frequency amplification, a vacuum valve detector, and with the power tube in the power-pack, three stages of low-frequency amplification. The coupling in these stages is provided by two double impedances and one low-ratio transformer. The use of a UX-210 type valve in the last stage eliminates the possibility of overloading and guarantees the best of tone quality, together with tremendous volume. The use of the McCullough AC valves eliminates all necessity for direct-current filament supply for filament lighting. While the power amplifier valve is a standard type, alternating current can always be used for supplying the filament of the valve used for this purpose. The AC filament-supply current is provided through a small step-down transformer which is included in the power-pack. This reduces the line voltage to the voltage requirements of these valves.

The high-voltage supply for the plates of the valves must be direct current, of course. This is obtained by means of a step-up transformer, the output of which is rectified and then filtered by means of the equipment contained in the power-pack. A standard UX-216-b type rectifier valve is used. The AC filament supply for this rectifier valve and also for that of the UX-210 type power-amplifier tube is obtained from the step-down winding on the power transformer.

As comparatively high voltages are developed in the power-pack, especially in the plate supply for the power-amplifier valve, all "live" parts are inclosed in covers, or are insulated, so that there is not the slightest danger of a person coming into accidental contact with these parts.

Precautions have been taken in the design to prevent possible damage to the reproducer resulting from the comparatively heavy current that flows in the plate circuit of the power amplifier valve, in which circuit the reproducer is connected. An output has been included in this circuit which keeps the direct current out of the reproducer windings and permits only the low-frequency, modulated current to pass through the windings.

The tone quality in this receiver is remarkably realistic. The same fine quality is obtained regardless of the adjustment of the volume control on the receiver panel. But by means of this control, the volume may be reduced to just the degree at which it is most pleasing to the operator. There is no hum to mar the reproduction, such as is encountered in some AC-operated receivers.

The selectivity is also excellent, providing a suitable antenna is used. In cities it will usually be found best to use an antenna not longer than 60 feet, including the lead-in wire. Out of town, where there are no nearby broadcasting stations a longer antenna may be used. In homes where alternating-current, house-lighting supply is not available this receiver cannot be used. The manufacturer, however, makes a similar receiver for operation with batteries to take care of such conditions.

Maker: Walbert Mfg. Co.

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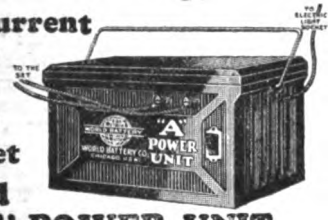

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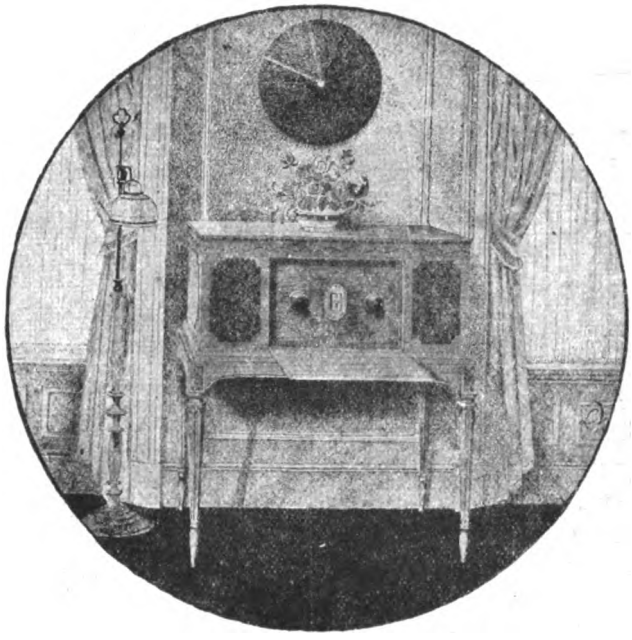

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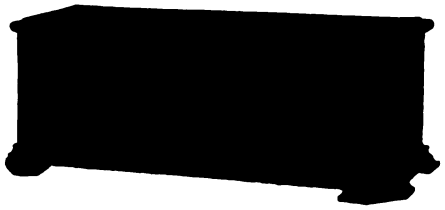

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7x26"	†21.00	23.00	1.82
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* For HiQ and Browing Drake Receivers.
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Whats New In Radio

(*Continued from page* 559)

should be around 75 feet. Out in the country this may be increased to any length desired. However, good results can be obtained with an indoor antenna. For those who prefer to use a loop antenna, provision is made whereby the first coil (antenna coil) can be pulled out and a strip equipped with plugs inserted in its place. The loop is then connected to the terminals provided on this strip.

The recommended valve equipment consists of 5 UX-201-a type valves for the four high-frequency stages and the first low-frequency stage; an old UX-200 (not 200-a) type valve for the detector; 2 hi-mu valves for the second and third low-frequency stages and a power valve for the last low-frequency stage. The three different types of valves specified for use in the low-frequency amplifier are made necessary by the use of a combination of transformer-coupled and resistance-coupled amplification. The power valve selected for use in the last stage is determined by the plate-supply voltage available. The best results and greatest volume are obtained by using a UX-210 type valve here, but this requires a "B" power-pack that will deliver at least 350 volts. The second choice is the UX-171 type power valve which operates with a 180-volt "B" power-pack. If dry cell "B" batteries are the only available source of high voltage, then the UX-112 or the UX-201-a type valves can best be used because of their lower current consumption.

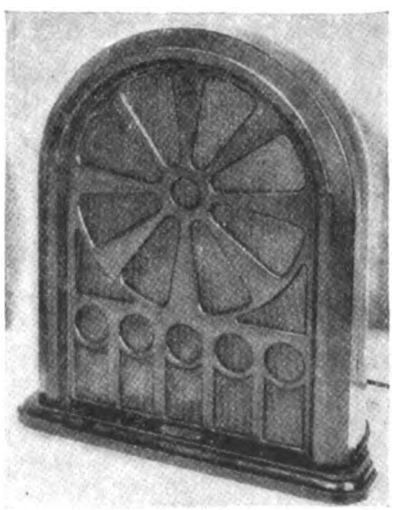
The use of the Leutz "B" power-pack is recommended with this receiver because it is designed to meet its special requirements. It provides three adjustable output voltages for the detector, high-frequency and intermediate low-frequency plate supplies and fixed voltages for the grid bias and plate supply of the power valve. This "B" power-pack is designed for use only where the house-lighting supply is 100 to 125 volts at 50 to 60 cycles.

The selectivity of this receiver may be judged by the fact that with the use of an outdoor antenna over 150 feet in length (the only one available at that time), it was found possible to separate WPG, the Atlantic City station, from WMSG, a New York station, while operating the receiver within approximately three miles of the latter. The wavelength difference between these two stations is only three meters. If they were any closer in wavelength they would heterodyne with one another.

Usage: For the reception of broadcast programs.

Outstanding features: Extreme volume of reproduction. Fine tone quality. Sensitivity to extremely weak signals. A high degree of selectivity. Totally shielded. Excellent workmanship.

Maker: C. R. Leutz Co.



A Unique Reproducer With a Metal Resonance Chamber

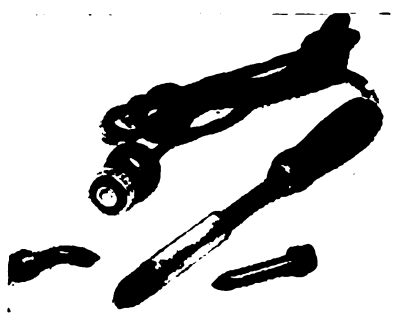
Name of instrument: Cone-type reproducer.

Description: This loudspeaker consists of an electric actuating mechanism and a free-edge cone, completely inclosed within an all-metal housing. An output transformer is included in the instrument to permit its use with receivers that include a power valve with high plate voltage for the last low-frequency stage. The metal housing is bowl-shaped in the back and serves as a resonance chamber, in addition to affording complete protection for the more delicate cone unit. The front of the case is a metal grill, backed up with wire gauze.

Usage: As the reproducer for use with any radio receiver.

Outstanding features: Excellent tone quality. Sturdy construction. Neat appearance. Moderate price.

Maker: All-American Radio Corp.



A Soldering Iron for Radio Constructors

Name of instrument: Electric soldering iron.

Description: This is a "single-heat" device which has much to recommend it for the use of the set builder. It consists of a heater element of special alloy, incased in a porcelain compound, which in turn is inclosed in a nickeled tubular case. The tips are screwed into one end of this case; the other end is attached to a black, oxidized-metal tube which extends through the wooden handle and contains the wires leading to the heater element. Where the wire comes out of the end of the handle it is protected by an "anti-kink" spring. The equipment includes three tips of different shapes to satisfy different requirements. Tips can be changed in a fraction of a minute. An extension cord and double attachment plug are provided with the instrument.

Usage: For any soldering work that requires the use of a light iron.

Outstanding features: Operates on 110-volt alternating or direct current. Draws only 75 watts. Spring protects cord from wear and breakage, thus preventing short-circuits.

Maker: Adroit Tool Co., Inc.

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What Shall We Do With Television?

(*Continued from page 522*)

would not be true for a surface dweller like man. Any man-containing steel tank, like the caissons used by divers near the surface, would be flattened to a pancake instantly by the pressure at the sea bottom. If we are ever to study with any adequacy the life and the living conditions on the bottom of the sea, it will have to be done in some other fashion than by sending any adventurer down to make a report.

A motion picture camera, equipped with its own light-producing apparatus and built strongly enough to withstand the external twelve tons to the square inch, is a distinct possibility, but a better possibility is television. With an electric eye at the bottom end of six miles of steel cable a scientist could sit comfortably in the cabin of his laboratory ship and watch by the hour the antics of those stilt-walking crabs and those lantern-carrying fish five thousand fathoms beneath his feet.

All of these possibilities which I have been amusing myself by imagining deal with the second variety of television; the variety employing definite links between one place and another. In my continued capacity of temporary prophet I am of the opinion that it will be some of these things which are first developed. Television broadcasting, for all that it was tried before the other system, seems to me much less likely to reach the first practical success.

When it does come it will depend, not upon the mere perfection of a process of television, but upon the development of some cheap form of television receiver, preferably some form which can be attached to ordinary radio receivers.

It has now come to be admitted, even by the most erudite and professional of musicians, that radio broadcasting is gradually producing an improvement in the public taste in music and in the public's knowledge of the great melodic works. The broadcasting of television would make it possible to do the same for that other fraction of the fine arts, painting and sculpture.

While this broadcasting of great art is perhaps the largest possibility in this direction, it is by no means the only one. Travel by television is a possibility. Airplane views of great spectacles, like the Grand Canyon or Niagara Falls, are possible without danger and without providing the thirty-million-odd airplanes which would be necessary to give our whole population a chance to see the show. Subjects which are taught in the universities by a combination of eye and ear (as, for example, experimental science is taught) could be broadcast by television and radio, losing little or nothing of their original vividness.

Television, when we have perfected it, will be very much worth having.

Better than ever!

The NEW
Mayolian
"B" SUPPLY
Type 614
The "B" Without a Buzz

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THE latest achievement of Mayolian Engineers—Type 614—will not hum or "motor-boat" with resistance-coupled or other receivers. Its high capacity filter ably takes care of the most severe fluctuations in current drain of any of the modern types of receivers. High-powered, uniform, noiseless!

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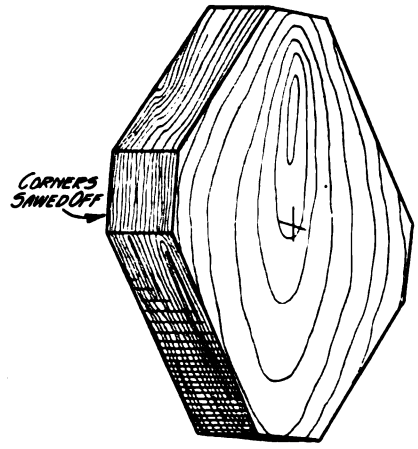
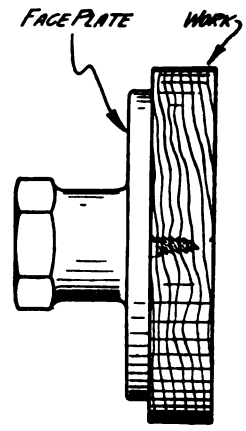
Your Laboratory Tools

(*Continued from page 551*)



RIGHT WAY TO TURN FLAT WORK

FIGURE 5: *By sawing the corners off a flat piece of work to be turned, the turning operation is hastened and the danger of splitting avoided. Before turning, be sure that the corners of the wood do not touch the lathe bed.*



THE USE OF THE FACE PLATE

FIGURE 6: *Flat pieces of wood for coil ends are best worked up by the use of the face plate with a screw center. The screw that holds the work to the plate can be seen projecting through the hollow hub of the plate into the wood.*

Now just a word about attaching the screw center or the spur center into the special chuck.

Two wrenches are provided for this purpose; one wrench is used to prevent the live spindle from revolving, while the second wrench is used to tighten the centers. One of these wrenches will also have to be used to hold the live spindle while a drill is being inserted in the drill chuck.

At this point a word of precaution will not come amiss. In turning out pieces such as shown in Figure 5, the mechanic will do well to make sure that the *edges of the piece will clear the bed of the lathe.* Otherwise the piece may strike the bed, break and injure the operator.

Light drilling jobs can be accomplished with the tool as illustrated in Figure 2. The work is held in the end and pressed against the cutting point of the drill. Unless the lips of the drill are ground off especially for cutting brass, the operator who is unaccustomed to the action of a cutting drill should take care to see that the work is not snatched out of his hand at the point where the drill breaks through. In the case of small drills, the drill would naturally break; the larger drills, however, will not do this—they will either bend or pull the work out of the operator's hands. Just before a drill breaks through cast iron or brass, the operator should release some of the pressure and permit the drill to "ease" its way through the final stages of the cut.

In Figure 1 we see the power lathe being used with its sawing attachment. Here, it will be noticed, a special table has been attached to the bed of the lathe and a circular saw placed on the live spindle. An adjusting saw guide is also attached to the table.

It is obvious that the operator must be careful with his fingers in using this attachment. He should also have some respect for the little motor, especially when he has a lot of cutting to do.

Although representing a great deal of power in a small space, this little motor will become hot if heavily overworked for long periods of time. Even when worked normally it will cut twenty times faster than a man can saw, to say nothing of the accuracy possible.

The grinding operation, for which a small special arbor and grinding wheel are provided, is illustrated in Figure 3.

With this attachment the operator may keep his wood-cutting tools, drills and chisels sharp. For those who are unaccustomed to the ways of the shop, it may be said that drills should not be sharpened too rapidly. Nothing loses its hardness so rapidly through overheating as a drill, and once made soft by being "burned" on a grinding wheel, a drill becomes practically useless except for working with wood and extremely soft metals.

In Figure 4 the operator is shown using a wire brush. This is a brush made with steel wire bristles and it is used in cleaning off metal surfaces. Some idea of other uses to which it may be put can be had from the suggestion that when used with the motor and independently of the lathe it is especially helpful in cleaning the underside of automobile mud-guards.

The clever mechanic will find a great many other uses for this little lathe. He can wind coils with it; he can cut and polish bakelite or he may, by rigging up different gadgets, accomplish a wide range of different operations. For after all is said and done, no tool will do work that is beyond the range of the mind of the man who uses it.

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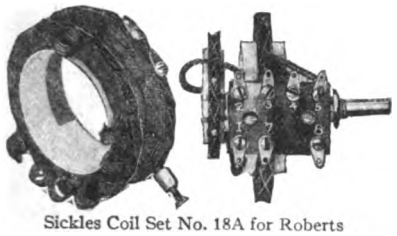

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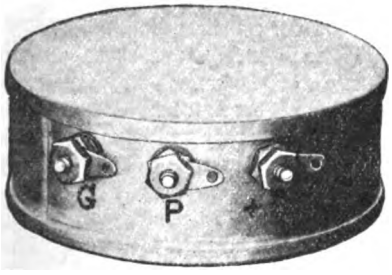

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No longer need radio reception be confined to one room — nor need battery wires be a tangled, unsightly mass strewn about the set. With the neat and efficient Yaxley Radio Convenience Outlets you can enjoy your favorite programs in any room in the house. Your batteries can be placed in the basement, closet or any out-of-the-way place and wires brought to set from Convenience Outlet with cable and plug that keeps wires together in an attractive way. Plug cannot be inserted incorrectly. Yaxley Radio Convenience Outlets are easily installed in any standard switch box.

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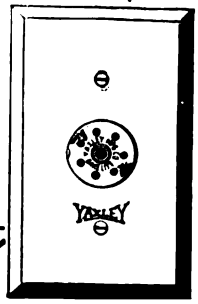

The "Radio Ceiling"

(Continued from page 553)

do explain some of the peculiarities of transmission.

"Fading," for example, which is one of the chief sources of irritation to the radio fan, is seen to be due not alone to interference between ground and reflected waves, but to changes in the height of the layer and in its effectiveness as a reflecting surface. The measurements obtained by the investigators showed that these changes are often very sudden; they also indicated that variations may take place with the season and with the time of day, the layer probably being at a greater height in fall than in summer and in the afternoon than in the morning.

Again, the character of the reflecting or refracting surface would naturally affect the quality of the reflected waves. A bumpy or corrugated surface would tend to produce "multiple reflections," causing interference, confusion and even "fading" where waves happen to neutralize one another.

For a long time scientists have been trying to learn what the forces really are which surround the earth, circulate within its interior and penetrate its atmosphere. Gradually progress is being made. It is now clear, for example, that the earth itself is surrounded by a magnetic field. It has also been shown that the sun has a magnetic field similar to that of the earth. It is probable that all celestial bodies are surrounded by such fields. Indeed, it has been suggested that every large rotating mass, such as the earth, is an electro-magnet that causes magnetic force in a manner not yet determined. Verification of the existence of a conducting layer in the upper air is another notable step forward in man's effort to understand and master the physical forces which surround him.

The existence of this layer has additional significance in the possibility that its movements in the earth's magnetic field may induce electric currents which, in turn, may have far-reaching effects. Again, the motion of the layer as a whole may affect the condition of the lower atmosphere, producing important changes in electric pressure.

The experiments here described were made with the cooperation of the Naval Research Laboratory, the Radio Corporation of America, the American Telephone and Telegraph Company, the Westinghouse Electric and Manufacturing Company, and the Bureau of Standards. The possibilities of the importance of the ionization of the upper atmosphere were pointed out first by Professor A. E. Kennelly, of the United States, and later, among others, by Oliver Heaviside, of England.

For this reason the layer is frequently called the "'Kennelly-Heaviside layer."

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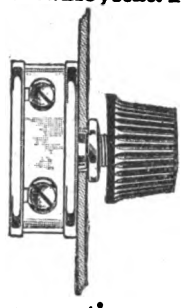
For noiseless, smooth filament control and maximum range, ask your dealer for the Bradleystat. This well-known graphite disc rheostat can be used for ALL TUBES, without change of connections. The bakelite knob is removable, if desired. The one-hole mounting makes the Bradleystat easy to install.



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Resistance-Coupled
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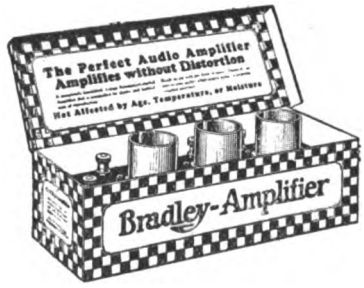
For perfect tone quality, use resistance coupling, and for convenience and reliability, ask your dealer for a Bradley-Amplifier. Ready to install in your radio set.



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FREE wiring diagrams showing use of X-L units in the new LOFTIN-WHITE constant coupled radio frequency circuit, and in other popular hook-ups. Send for yours today.

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We announce a new 2-watt Veritas Resistor, intended for all usual grid-leak and resistor uses where the radiation requirements do not exceed 2 watts, and intended to replace old type resistors and grid leaks in which the resistance element is separately enclosed within a glass tube, and which are only 1/10 to 1/20 as able to carry current safely. In spite of much greater value, 2-watt Veritas Resistors sell for no more than the old style. They stand up in service, are accurate, changeless and can be soldered, too, without damage.

The TOBE 5-watt Veritas Resistor is still part of the Veritas line. In addition we now present to the Radio Public a 10-watt resistor with all the excellent Veritas characteristics and suitable for use in large B-Eliminators and Power-Supply units. Send for catalogue *L-6.*

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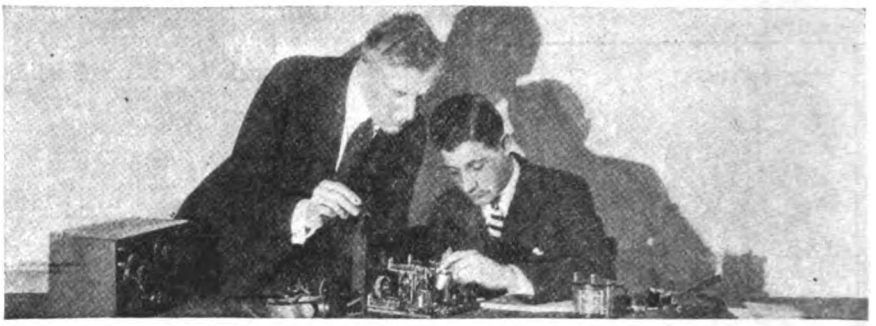


WITH THE EXPERIMENTERS

CONDUCTED BY RICHARD LORD

"Stereophonic Reception"

EVEN with the most perfect of loudspeakers, it is not possible to get exactly the same musical effect from the reproduction as would be obtained if the listener were seated in a hall listening directly to the performance. The same observation applies to a phonograph.

The reason for this is not far to seek. In a concert hall the sound reaches the listener from practically every angle, due to reflections from the walls, roof and various objects within the building. These complex reflected sound waves are picked up by the listener's ears, but, due to the fact that he has *two* ears, the impression transmitted to his brain is somewhat different from that which he would receive if he had but one ear, on account of what might be termed "phase difference."

This phase difference is caused by the distance between the ears. Sound waves from the right will reach the right ear a small fraction of a second before they affect the left ear, and *vice versa.*

This state of affairs results in giving us the effect of hearing from several points at once, so that when we are listening to an orchestra in a hall we get a sense of perspective; all the instruments in the orchestra combine and blend to give us the desired effect.

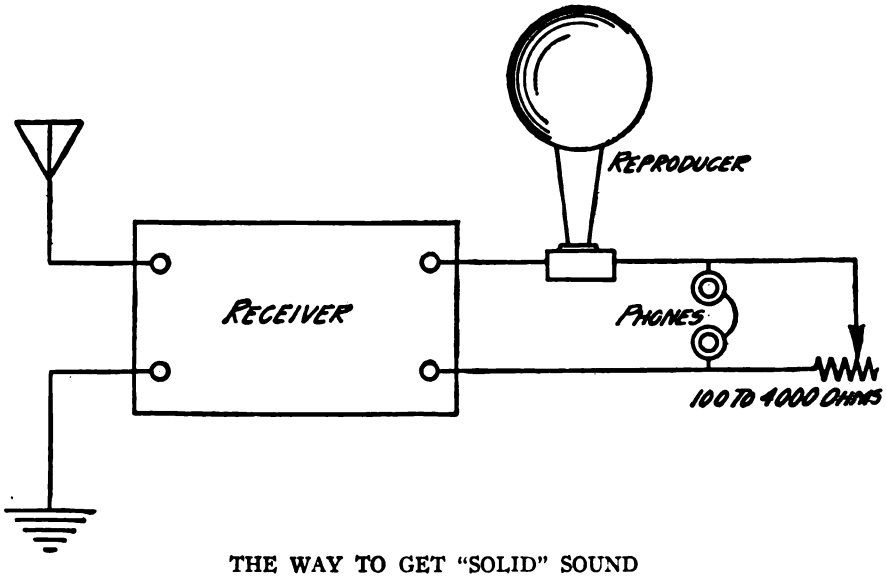
This effect is further assisted by the fact that the orchestra is spread out over a relatively considerable area.

When listening to a broadcast reproduction of the same performance, however, the effect is totally different. Even if the loudspeaker and its associated amplifier are perfect, the effect still seems to be "flat." It is like the difference between looking at a photograph through a stereoscope and then looking at it without the aid of such an instrument.

This is one of the artistic faults of broadcasting, and it is due primarily to the fact that the microphone has, by virtue of its design and construction, but **one ear.**

Several microphones may be used, but they will not greatly improve the situation, because all their outputs have to travel over a single circuit only, in order to reach the broadcast listener, *i.e.,* the ether. (In the case of the phonograph, of course, the medium of transmission is the record.)

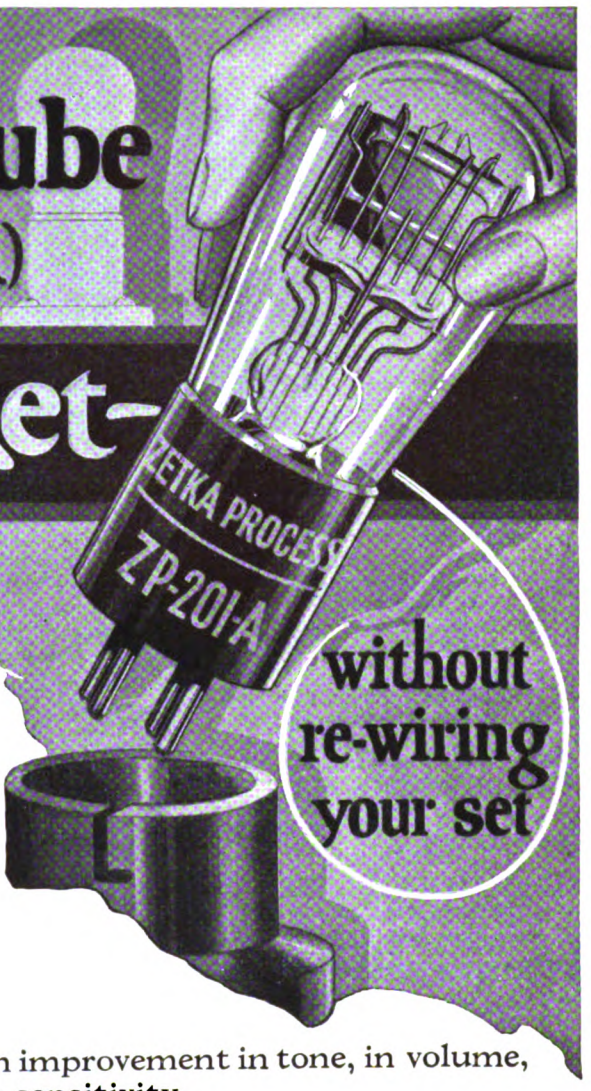
Thus, up to the point of reproduction by the loudspeaker, there is no phase difference between the various sound



THE WAY TO GET "SOLID" SOUND

FIGURE 1: *By means of the variable resistance shown at the right of the diagram, the volume of sound from the headphones is balanced with that from the loudspeaker. The two reproducers sounding together gives the "stereophonic" effect.*

Put a Power tube (¼ amp. ZP 201-A) in Every socket—



without re-wiring your set

Radio's sensational development has seen nothing more startling than the new ZP 201A, oxide filament, ¼ amp. Power Tube—the Zetka Process power tube for every stage.

Now, for the first time, can power tubes be used in every socket of your set. Now you can enjoy *real* power, and *without changing a single wire!*

Replace your old 201A's with a set of these new ZP 201A's and enjoy the most startling achievement in tube history.

There is appreciable current saved, both A and B—it is not necessary to hook up additional C's—but—what an improvement in tone, in volume, in sensitivity.

Only $2.50 each at your nearest dealer puts a complete Power Tube set well within your radio budget. And then only you'll enjoy real radio satisfaction—with power tubes of longer life, that increase in efficiency as you use them.

Ask your Zetka dealer to show you the Zetka Weston meter test. You'll want nothing but Zetka thereafter.

YOUR SET DESERVES THIS FINER EQUIPMENT
PRICES NO HIGHER

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Courtesy of the Bakelite Corporation

"A CAPACITY EQUAL TO THAT OF THE EARTH"

Here is a view in a large manufacturing plant whose monthly output of fixed condensers has a total capacity that equals that of the earth, considering it as one gigantic fixed condenser. The small condensers shown in this picture are made of bakelite, mica and tinfoil.

waves; or rather, instead of two sets of sound waves, slightly out of phase with one another, there is but one set.

The music of a full orchestra thus reaches the radio listener from but one definite point in space, which is unnatural. For really natural reproduction, not only is the phase difference itself essential, but it must also constantly vary so as to give the impression of hearing from several points at once—the different points where the instruments are placed.

The echo effects present in a large hall must also be taken into consideration, as has lately been successfully done at 2LO, London, where a special room is set aside for the production of an echo effect.

At first sight the difficulties in the listener's path seem to be insurmountable. To correct the transmission two separate transmitters and receivers would be necessary, which, of course, is impractical.

However, it is quite practicable for the listener to produce a phase difference at the receiving end, the results of which will give an extremely pleasing effect; this may be arranged in a few minutes without the necessity of altering the set in any way, or adding any complicated apparatus.

Given a receiver capable of good loudspeaker reproduction, all we require is a pair of headphones and a resistance variable between about 100 and 4,000 ohms. The hook-up is given in Figure 1, and is simplicity itself.

The station should be tuned into maximum strength on the phones, which, by the way, should not fit too tightly on the head. The loudspeaker is then moved away from the listener till a slight echo effect becomes apparent. About 10 or 15 feet ought to suffice.

The variable resistance should then be used to regulate the strength in the phones till their effect upon the ear is approximately equal to that of the reproducer. A marked improvement in the quality of reproduction will then be apparent, due to the phase difference introduced by the distance between the loudspeaker and the phones.

The essential point is that the intensity of the sound that reaches the ear from both sources should be as nearly equal as possible. Hence the advisability of wearing the phones loosely.

This phase difference varies in extent with the frequency of the reproduced sounds, and it is this constantly varying phase difference which produces the stereophonic effect so superior to ordinary reproduction, for the sound waves appear to reach the ears of the listener from all directions at once, just as they do in the concert hall.

Much has been done in England to secure this phase difference at the transmitter, by means of the echo room already referred to. In this room, which is bare, a loudspeaker reproduces the program from the studio. This speaker is supplied by a separate microphone set alongside the broadcasting microphone, and it has its own amplifier. In the echo room there is also a third microphone, set some distance away from the loudspeaker. The output of this microphone is superimposed upon that of the studio microphone, and the two outputs have a phase difference which can be regulated by varying the distance between the echo-room microphone and the loudspeaker.

By means of this combination extremely realistic reproduction can be obtained, even from a draped studio performance. The engineers responsible for the development of the method claim that they can pick up an open-air band and broadcast it as if it were playing in a large, echoey hall!

This same principle of the introduction of phase difference can also be applied to a phonograph and suggests a line of research for the phonograph industry.

Two distinct reproducing systems are

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necessary, complete with sound boxes and horns of similar characteristics. Two needles are placed in the same groove of the record, one about 2½ to 3 inches behind the other, according to the character of the music. By this means surprisingly realistic reproduction may be obtained.

—A. DINSDALE.

What Condensers Are Doing for Man

THE Leyden jar has formed the basis of one of the principal means of harnessing electrical energy so that it will perform the many tasks set for it by man. At first this important device served as a mere toy; it was used in the beginning to send an electric shock through a chain of soldiers or monks for the amusement of royalty. The Leyden jar (named after the town in Holland where it was first made known to the public), is the foundation of the fixed condenser.

Until recently the Leyden jar served its purpose as a condenser with little improvement over the original types. It was most familiar as part of the doctor's X-ray machine.

As radio came into more general use, the development of the condenser grew apace; today condensers are made in a variety of forms—variable and fixed, with air, paper, or mica dielectrics—and they range in size from tiny devices one inch square for radio receivers, to the larger units for high-tension transmission lines, encased in bakelite, and porcelain tubes the diameter of a gallon jug.

Condensers as they are used today help to smooth out the rough spots in the flow of electricity. As potential storehouses of electrostatic energy, they are used to break the gap in the starting and stopping of elevators and other kinds of motor-operated machinery where there are electrical contacts.

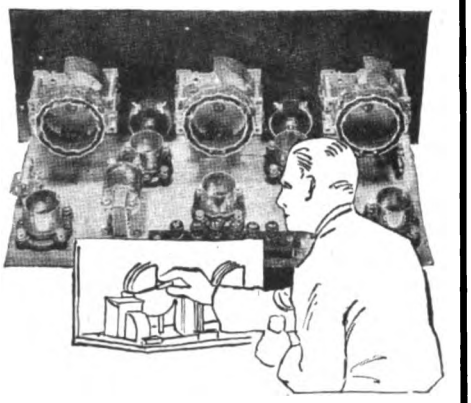
In power transmission they serve in a number of ways. They perform an interesting service by permitting the use of high-tension power lines for telephoning. Variation in the capacity of the condensers permits the sending and receiving of a number of messages at once, without interference. Condensers are also employed to drain telephone lines of undesirable high-frequency currents. Instead of this form of energy being reradiated into the ether, the condensers carry off the interference to the ground.

The combination of condenser units to effect varying capacities is another of the unique features of these controlling devices. Automatic railway signals are operated through the use of such condensers to insure the safe operation of our railway systems.

Were it not for the condenser, radio would be a lost art, for in tuning there must be some means of adjusting the receiving instrument to the frequency set up by the sending station. This is nearly always accomplished by the condenser.

$75 A WEEK BUILDING RADIO SETS

—*in your spare time*



JOIN the Radio Association of America. Learn how to build and repair radio sets. The Association will train you—start you out in business if you wish. Be the radio "doctor" of your community. $3 an hour upwards easily made. Radio offers you a big money-making opportunity right now.

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"I have at last found myself," writes Lyle Follick, Lansing, Michigan. "I have already made over $500 building radio sets after working hours." Werner Eichler, Rochester, N. Y., writes, "I have made over $50 a week in my spare time."

Our members are starting radio stores, increasing their salaries, securing better positions, earning big money for the most enjoyable kind of spare-time work.

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A membership in the Radio Association of America gives you the most up-to-date and thorough training in the Science of Radio.

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If you're interested in Radio for either pleasure or profit, join the Association without delay, because we have a plan whereby your membership may not—need not—cost you a cent. Only a limited number of these memberships are acceptable. Write now for details. Write before it's too late.

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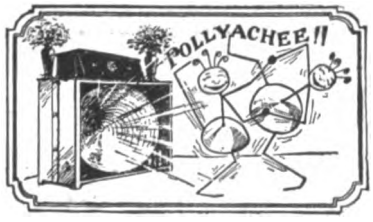

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In the World's Laboratories

(*Continued from page 563*)

Another Chance for Radio Tests of the Sun

AMERICAN radio enthusiasts will remember the extensive tests of the effect of the sun's shadow on radio waves which were made in the United States during the total eclipse of the sun in January, 1925. It was these tests which furnished one of the first sure pieces of evidence concerning the Heaviside Layer and the part played by this upper level of our atmosphere in radio matters.

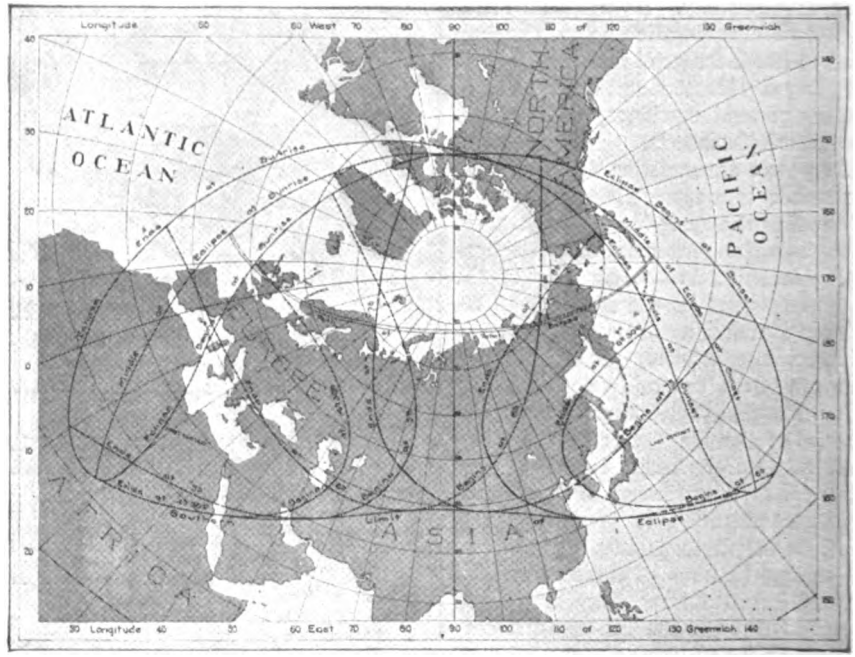
Last year there was another total eclipse of the sun, but it happened to be visible only in the Indian Ocean, on the east coast of Africa and in parts of the islands of the western Pacific Ocean. This region being ill-provided with radio stations or with listeners, few radio tests were made and no further important facts seem to have come to light.

On June 29, 1927, there will be still another total eclipse of the sun. This one, fortunately for science, will be total in thickly settled countries well provided with radio listeners and with broadcasting stations.

The eclipse begins, in early morning by local time, about four hundred miles southwest of the British Isles. At about five thirty, A. M., Greenwich Time, the eclipse sweeps across England in a northeasterly direction, from North Wales and Liverpool to Hartlepool, a port on the North Sea. A little later the eclipse will be total at Stavanger, in southwestern Norway, will sweep northward along the whole length of that country and will then traverse the portion of the Arctic Ocean north of Asia, perhaps the least populous ocean of the world. In the later afternoon, still according to local time, the eclipse will be visible as a total one in parts of eastern Siberia, where it will be enjoyed, we imagine, by no one except the Eskimos. At sunset, the eclipse ends in the Northern Pacific Ocean, just south of the Aleutian Islands.

The eclipse will be visible, as a partial eclipse only, in parts of Alaska and in Greenland. This continent will have no glimpse of it as a total one and even the partial eclipse will be invisible in the thickly-settled portions of our side of the world. The favorable points for observation will be in England and in Norway, and expeditions from many astronomical observatories in all parts of the world will be stationed at vantage points along this portion of the path. Extensive plans are being made in England for public observation of the eclipse, along the lines carried out so successfully for the American eclipse of 1925 by Professor Ernest W. Brown, of Yale University, and his assistants. It is planned, also, to enlist British radio fans in repeated tests of the effect of the passage of the sun's shadow on radio transmission.

It is probable that the effects of the eclipse on radio will be, in some degree,



From the Nautical Almanac, 1927

WHERE THE SUN WILL OFFER ANOTHER RADIO EXPERIMENT

This map, prepared by the astronomers of the United States Naval Observatory, shows the parts of the earth which will be shaded, totally or partially, by the moon's shadow during the total eclipse of the sun on June 29, 1927. The narrow double line, marked "Path of Total Eclipse," indicates the only places which will see the sun totally obscured.

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If your local dealer cannot supply you with Blueprints of the LC-27 Receiver, they will be sent post-paid upon receipt of $1.00.

A full description of this Receiver, with detailed directions for building, was published in the October, 1926, issue of POPULAR RADIO. Send 35 cents for a copy.

We also have Blueprints of The LC-Senior Power-Pack, The LC-Intermediate Power-Pack and The LC-Junior Power-Pack which were designed to operate The LC-27 Receiver.

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world-wide; as the effects of the 1925 eclipse seemed to be. Accordingly, amateurs who are working in America during the hours of the eclipse should record carefully any unusual observations which come to their attention. As this note is written it appears unlikely that any organized effort will be made to obtain American observations, but the editor of this Department will be glad to forward any incidental observations to the European scientists who are in charge of the observations there.

The American hours corresponding to the occurrence of the eclipse in Europe and Asia are as follows: The partial shadow will first strike the earth, in the Atlantic Ocean and in northeastern Africa, at about 11.30 P. M. on the evening of June 28, Eastern Standard Time. Totality will begin, in the Atlantic, about an hour later. The sweep of the shadow over the British and Scandinavian radio stations will last from approximately 12.20 A. M. on the morning of July 29 until about ten minutes later. The duration of totality at any one point on this part of the eclipse path will be only 24 seconds. By about 1.30 A. M., Eastern Standard Time, the total phase of the eclipse will have reached the Aleutian Islands and ended. The partial phase of the eclipse will end at about 2.30 A. M.

Mathematical details of the eclipse path, times and similar matters are printed in the Nautical Almanac for 1927, published by the United States Naval Observatory and for sale by the Superintendent of Documents, Washington, D. C., at one dollar a copy. For facts about eclipses in general any good textbook of astronomy may be consulted; that by Professor E. A. Fath, published by the McGraw-Hill Book Company, New York City, is good, as is also the new edition of Young's Astronomy, edited by Professor Henry Norris Russell, of Princeton University, and published by Ginn & Company, Boston.

The Theory of Antennas

RADIO engineers interested in the more fundamental (and mathematical) theories of the science should not miss a discussion of the space characteristics of radio antennas published recently by Captain William H. Murphy of the Signal Corps of the United States Army.* Captain Murphy applies to the characteristics of receiving antennas the general electrostatic equations for electric fields in space.

Perhaps the most interesting parts of his discussion are those dealing with the directional characteristics of receiving antennas and with the displacements of phase angle which may occur.

* "Space Characteristics of Antennæ," by William H. Murphy. *Journal of the Franklin Institute* (Philadelphia), volume 203, pages 289-311 (February, 1927).

SM

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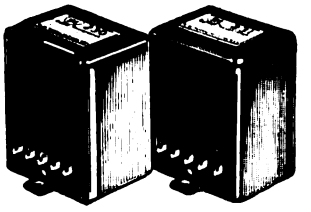

Two new audio frequency transformers have just been released by the Silver-Marshall laboratories, which, used with two 112 or 171 type tubes, will provide greater power output without overload distortion than the most powerful 210 amplifiers heretofore used.

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Type 230 input transformer may be used as a 3:1 or 6:1 ratio audio transformer, or as a 3:1 push-pull input transformer. Its characteristics are very similar to those of the famous 220—effective primary inductance 100 henries, with falling curve from 30 to 5,000 cycles.

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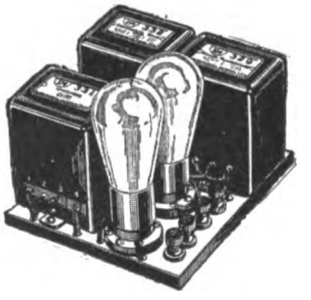

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A.—By production on a scale never before attempted.

Q.—*Why is Pilot's manufacturing method unique?*

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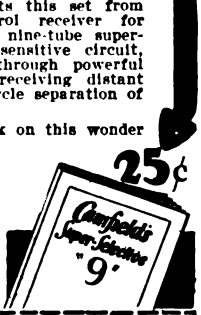

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Are Radio Waves Injurious to the Blood?

THAT having radio "get into the blood" may actually be more than a mildly derisive figure of speech is the interesting, although somewhat ill-supported, suggestion made in a recent article by Mr. Bernard Leggett, Radiologist of the East London Hospital for Children, in London, England.*

As is usual among the medical profession, the title of radiologist does not refer to any item of radio (which Englishmen call "wireless" anyway) but indicates that Mr. Leggett is an X-ray expert, charged with the care and operation of the hospital's outfit for this useful surgical accessory.

Mr. Leggett's discussion of the possible effects of radio or other electric oscillations on the blood of human individuals begins with the field which he knows best, that of the much shorter ether waves of the X rays. The dangerous effects of these rays upon the human body are well known, as are also the somewhat analogous effects, dangerous or beneficial, of the next longer waves of the ultraviolet rays. Mr. Leggett points out, also, that it has been observed by many workers with X rays that changes in the composition of the blood have been observed not infrequently in persons who work much with X-ray apparatus.

Physicians set great diagnostic value, nowadays, upon the exact percentage of red blood corpuscles in the blood, upon the proportions of different kinds of corpuscles among the other, or "white," corpuscles, and so on. Blood tests are made frequently, not only upon invalids but upon well persons who observe the sensible precaution of obtaining periodic physical examinations. Workers with X rays have been found to show, more frequently than is normal, blood changes which cannot be other than injurious to health.

When such injuries have been observed they have usually been ascribed to undue exposure to the X rays themselves, in spite of the precautions taken in all modern X-ray laboratories to protect the workers from these radiations. Mr. Leggett suggests, however, that the true cause may be some hitherto unsuspected effect of the high-frequency oscillations, closely resembling radio waves, which are produced and emitted by the transformers and other apparatus used to produce the high-voltage currents which operate the X-ray tubes. If so, he goes on, the same effects ought to be perceptible among electricians who spend much time in the neighborhood of powerful alternating-current generators or motors, and still more among the persons similarly employed with radio apparatus.

* "Radiological Blood Changes," by Bernard Leggett. *British Journal of Actinotherapy* (London), March, 1927, pages 24-25.

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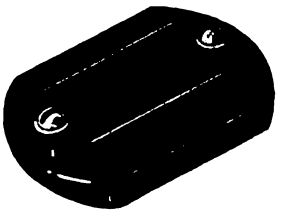

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December, 1926
—Uncle Sam's New Short-Wave Net.
—How Circuit Resistance Affects Selectivity.
—POPULAR RADIO Circuits.
—How to Build the LC-Intermediate Power-pack.
—Inside Information on New Radio Receivers.

January, 1927
—How to Build the New KH-27 Receiver.
—To Start and Stop Your Set Automatically.
—POPULAR RADIO Circuits.
—The Quack Doctors of Radio.
—How to Build the LC-Junior Power-pack.

February, 1927
—The Coming of the "RADIO UNIVERSITY."
—How to Get Quality Amplification.
—How to Build and Use a Portable Test-Board.
—How to Assemble the All-Amax Senior Three-tube Reflex Receiver.
—What's New in Radio.

March, 1927
—How to Build the Univalve Receiver.
—POPULAR RADIO Circuits.
—How to Increase the Range of Ammeters and Voltmeters.
—How to Build Your Own 36-Inch Cone Loudspeaker.
—What's New in Radio.

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Do electricians show such effects?

Mr. Leggett admits that he does not know. He has never known, he says, any electrician of distinctly lethargic temperament. Instead, persons of this profession seem to incline to nervousness. These are admittedly mere guesses. No facts are known either way.

It is obviously foolish to get in the least excited about these suggestions, so long as they are mere suggestions, without definite facts to back them up. Nevertheless, it is possible to record a hearty second to Mr. Leggett's suggestion that the matter be put to the test by making a series of blood tests of a large number of persons whose occupations compel them to associate closely with machines emitting powerful alternating electric waves. It would be no great task to make some hundreds of such tests on, for example, the dynamo tenders of some large power company, discovering whether or not these much electrified individuals differ from the mass of the population in any recognizable character of the blood. It is to be hoped that someone will undertake such a test.

Do "Polar Fronts" Affect Radio Waves?

ALTHOUGH there have been innumerable discussions of the relationship between weather and radio, with almost as many proposed theories as there have been theorists, the matter is still impenetrably obscure. That is what gives interest to a recent discussion of the so-called "polar front" theory of weather, as applied to American weather.*

This theory, developed by the famous Norwegian meteorologist, Bjerknes, for the weather of North Europe, assumes that most of the changes of weather which occur in our temperamental northern climes are related to the arrival of great masses of cold air from the neighborhood of the North Pole. These blocks of air are supposed to mix but little with the warmer air farther south, except along the margins of the blocks. They are almost like icebergs in the air.

The margin, where much mixture does occur, is the "front" of the polar air mass; hence the "polar front" designation of the theory. Storms and temperature changes and other weather vagaries are due, the Norwegian school of meteorologists insists, to the violent air circulation which is produced along this front. It is like the boiling wall of water at the front of a flood.

This, in rough outline, is the theory—a theory now increasingly popular among professional students of meteorology.

Captain Reginald Bureau, of the

* "Application of the Polar Front Theory to a Series of American Weather Maps," by Carl-Gustaf Rossby and Richard Hanson Weightman. *Monthly Weather Review* (Washington, D. C.), volume 54, pages 485-496, with seven maps (December, 1926; issued February 26, 1927).

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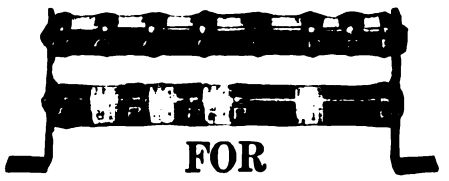

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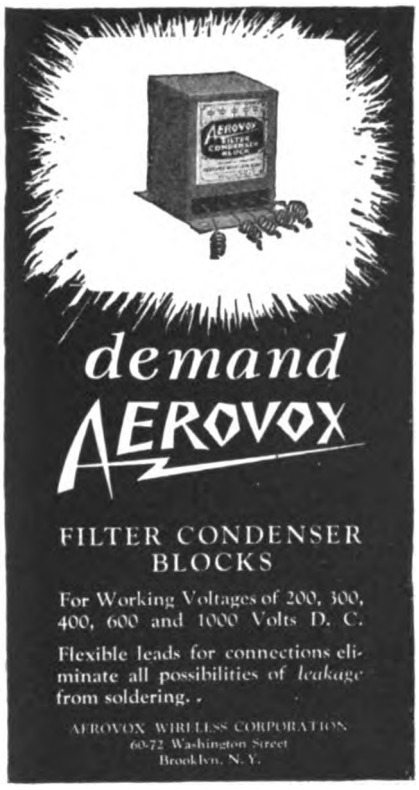
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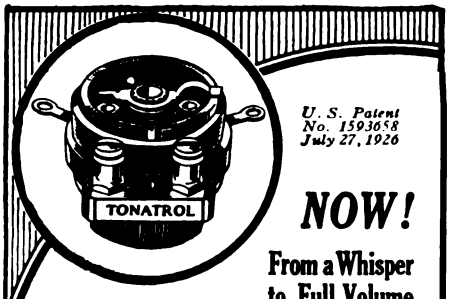

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The most efficient and perfect instrument ever invented for controlling tone and volume! Enables you to regulate volume evenly from the softest music to the most powerful reverberating tones.

"TONATROL" is a smart addition to any set. Very neat in design and made of genuine Bakelite. Easy to install.

TONATROL — Standard Volume Control—Price $1.50

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Write for free installation booklet for the correct way to control volume.

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ELECTRAD Inc

French radio service, has applied this polar front theory to radio conditions in Europe, tracing much of the static and other disturbances encountered in France and Switzerland to the electric changes which accompany the violent agitation of the air along such a polar front. Neither in weather science nor in radio has the polar front theory been worked out in detail for American conditions. The paper referred to above is a good beginning from the meteorological side. Now is the time for some radio enthusiast to undertake experiments on the radio side.*

* To such prospective enthusiasts there is to be recommended the comprehensive and admirable monograph on meteorological physics, entitled "The Physics of the Air," by Dr. W. J. Humphreys, of the United States Weather Bureau, published by the Franklin Institute, Philadelphia, Pa., at a price of six dollars.

Why a Magnetic "B" Battery Eliminator is Improbable

FOR over fifty years it has been known that when thin plates of the element bismuth are placed in intense magnetic fields an electric current flowing simultaneously through such bismuth plates is deflected to one side in a fashion which makes it possible to obtain a very small difference of voltage between one edge of the bismuth and the other.

This is the effect known, after its discoverer, as the "Hall effect."

Last year Professor Palmer H. Craig, formerly of the University of Cincinnati, published results indicating that the electromotive forces thus obtainable might be much larger than previous investigators had supposed.† Some months later Professor Craig, then at Mercer University, inspired newspaper dispatches claiming that it is possible to make use of this effect to obtain considerable voltages, probably useful for radio purposes.

Physicists familiar with the Hall effect and with the difficulty of measuring with accuracy the small voltages which this phenomenon is competent to produce were sceptical of Professor Craig's suggestion and further announcements of its success do not seem to have appeared. Instead comes an experimental paper by Dr. C. W. Heaps, of the Ricè Institute, who has repeated Professor Craig's earlier work and finds himself unable to confirm it.§ The voltages found by Professor Craig are far too large to be real, Dr. Heaps believes. Perhaps there was some leakage in the apparatus or some other error.

And so another illusory hope of using some little-known physical effect to get rid of radio batteries departs, not much lamented, to its grave of obscurity.

† "The Hall Effect in Bismuth with Low Magnetic Fields," by Palmer H. Craig. *The Physical Review* (Minneapolis, Minn.), volume 27, pages 772-778 (June, 1926).

§ "The Hall Effect in Bismuth with Small Magnetic Fields," by C. W. Heaps. *The Physical Review* (Minneapolis, Minn.), volume 29, pages 332-336 (February, 1927).

Delano, Paris

A FRENCH LOUDSPEAKER

This device, which the inventor, M. Felipe Saldana, is demonstrating, is said to attain unusually good quality by several novelties of construction, including a membrane of a synthetic organic compound

A New French Loudspeaker

A LOUDSPEAKER capable of developing unusual volume, yet of relatively small size, has been invented by a Parisian engineer, Mr. Felipe Saldana. The movement is of the usual electromagnetic type, a magnetized armature being caused to vibrate in synchronism with the electric oscillations. The novelty of the Saldana instrument consists in two things: the system for transmitting the armature vibration to the diaphragm and the material of which this diaphragm is made.

The transmitting system consists of several metallic rods, all attached to the armature and to the diaphragm, instead of the usual single rod. The object is to prevent any selective resonance or selective transmission by the rod itself, due to its own natural period of vibration. The system of several rods is said to insure undistorted transmission of all audio frequencies from the armature to the diaphragm.

The diaphragm consists of a sheet of synthetic material said to be a compound of cellulose with an organic acid; evidently a material of the type of the cellulose acetate used for airplane wing dope or for certain kinds of motion picture film. Materials of this type are now made in sheets of various thicknesses, but the substance has not previously been tried, so far as known, for diaphragm material. As employed in the new Saldana instrument it is said to give a less distorted reproduction than any other diaphragm material yet used.

It is generally admitted that the materials now used for loudspeaker diaphragms are far from satisfactory. Metals are ideal, except that none of them are light enough. Experimentation with organic membrane materials such as that employed by Mr. Saldana should be encouraged.

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SUMMER IS HERE

Build the "Town and Country" Portable Receiver with Simplified Blue Prints

The "Town and Country" Portable Receiver, developed by the POPULAR RADIO LABORATORY and described in the July, 1926, issue, marks a decided advance in portable receiver design. While not a "vest pocket" receiver, the new "Town and Country" is small enough to be taken along on a motor boat or train trip. Efficiency has not been sacrificed for the sake of compactness.

The receiver uses six UX-199 tubes and one UX-120 power tube. Operating on a loop, tone quality is guaranteed by the use of a fundamentally correct circuit, high-class transformers and cone-type speaker.

The "Town and Country" Portable Receiver is mounted in a special mahogany cabinet with a drop front and is equipped with a carrying handle. All equipment, including the folding loop, cone loud-speaker, batteries and connecting cable, is installed in a suitcase. Connections from the equipment to the set are made by means of jacks and plugs.

By using POPULAR RADIO Blue Prints in building your "Town and Country" receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory model.

If your local dealer cannot supply you with Blue Prints of this set, they will be sent postpaid upon receipt of $1.00 per set.

POPULAR RADIO
Service Bureau 44-D
627 W. 43rd St., New York City

A New Fact About Hearing

THE peculiarities of the human ear are so important to the successful use of radio and are so well known to radio experts that much interest attaches to the recent discovery of Dr. Stacy R. Guild, of the University of Michigan that the basilar membrane in the ear of guinea pigs is an exceedingly variable anatomic structure.* The basilar membrane will be recalled as that short ladder-like strip of tissue coiled up inside the spiral portion of the ear of man and of other vertebrates. It is generally assumed that nerve fibres attached to the different "rungs" of this living ladder form the mechanism by which we recognize the pitches of different tones. This theory assumes that the rungs of the ladder increase in length gradually and uniformly, from one end of the ladder to the other.

Dr. Guild finds by examination of the ears of many guinea pigs that this is not true. Instead, the ladder seems to vary in width irregularly from one end to the other. Furthermore, the character of the ladder varies greatly in different animal individuals.

*"The Width of the Basilar Membrane," by Stacy R. Guild. *Science* (Lancaster, Pa.), volume 65, pages 67-69 (January 21, 1927).

A New Name for the Heaviside Layer

FEW radio theories have aroused more controversy than that of the Heaviside Layer, the upper region of our atmosphere which is supposed to be electrically conductive and to have such important effects on radio. Not only had the existence of this famous Layer been hotly denied and as hotly affirmed, but the halls of radio societies have resounded to equally vociferous arguments concerning its correct name. The existence of this Layer appears to have been suggested independently by Mr. Oliver Heaviside and by Professor Kennelly.

Now appears a new candidate for the name. In a letter to the London scientific periodical, *Nature*, Dr. Charles Chree, the distinguished British expert on terrestrial magnetism, asserts that neither Mr. Heaviside nor Professor Kennelly first had the idea of the Layer, but that it was mentioned first by Dr. Balfour Stewart in his article on terrestrial magnetism in the ninth edition of the Encyclopædia Britannica, written about 1882.* Dr. Chree gives the references as sections 121 and 134 of this article. Dr. Stewart's reason for assuming the existence of the conducting layer high in the atmosphere was the existence of certain daily changes in earth magnetism, which changes are most easily explained by assuming tides raised by the sun and moon in the electrified material of the Heaviside region.

*"Wireless Communication and Terrestrial Magnetism," by C. Chree. *Nature* (London), volume 119, pages 82-83 (January 15, 1927).

Dealers attention! Free

UP TO DATE LIST of WHOLESALE PRICES

The May list of radio specials is now ready.

12-hour shipments.

Due to Walthal's famous purchasing power, you can get those hard-to-get items that set-builders demand. More different makes, a more complete line of items than is carried by any other distributor in the United States.

We carry full lines, such as All-American, Thordarson, AmerTran, Balkite, Tungar, Westinghouse, Ward Leonard, and every well-known make.

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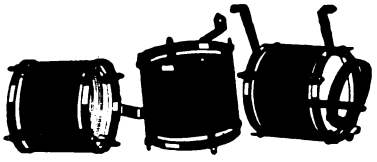
Use These Coils and Improve Any Radio Receiver

AERO COIL
SUPER-SENSITIVE
INDUCTANCE UNITS



Tuned Radio Frequency Kit

$12.00

This Aero Coil Tuned Radio Frequency Kit will positively improve the performance of your receiver. It is the basic reason for the splendid performance of the 5-tube Aerodyne Receiver described in this issue of POPULAR RADIO. Special patented Aero Coil construction eliminates radio freqency losses. You will notice instantly a tremendous improvement in volume, tone and selectivity.

This kit consists of three matched units. The antenna coupler has a variable primary. Uses .00035 condenser. Coils are uniformly air spaced. No dope is used. Consequently they tune into resonance on a "knife's edge."

FREE with Each Kit

Eight-page color circuit, layout and instruction sheet for building the super-sensitive 5-tube Aerodyne Receiver, described in this issue, packed with each kit. Extra copies, 75c each. Instructions include insert showing how to wire up for a power tube if desired.

Get these coils from your nearest dealer. If he can't supply you, order direct from the factory.

AERO PRODUCTS, INC.
Dept. 104 1772 Wilson Ave.
CHICAGO, ILLINOIS

The News of Mars

As USUAL, the recent near approach of the planet Mars to the earth produced a group of reported radio signals supposed to emanate from that interesting member of our solar family. As before, however, none of these supposed Martian radiograms possesses the slightest real indication of having come from the planet or of representing anything more mysterious than the miscellaneous clicks, crashes, squeaks and what-not which commonly animate our long-suffering ether.

Sensitive radio receivers, erected in England for the announced purpose of listening to Mars, obtained, as they did two years ago, an assortment of unusual and unexplainable noises. Inasmuch, however, as such unexplainable noises may be obtained without difficulty in much less sensitive radio receivers erected anywhere on earth, neither the astronomers nor the radio engineers are inclined to place any great reliance upon the British reports. An assortment of "psychic" gentlemen have also announced the receipt of direct messages sent to them from Mars telepathically or in similarly mysterious fashions. Naturally, scientists are disinclined to consider these reports otherwise than as material for amusement.

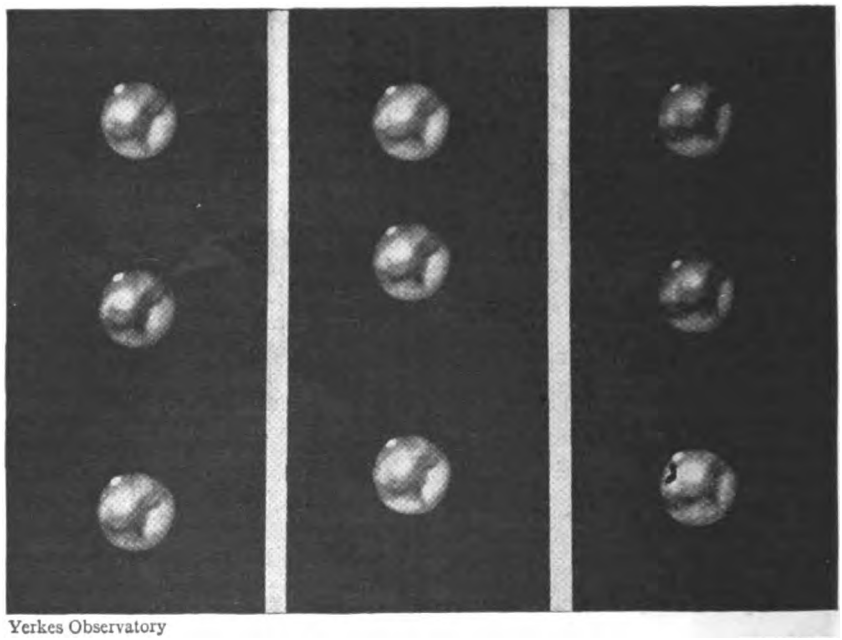
The real scientific investigations which have been conducted during the past six months in many of the world's great astronomical observatories have not yet been computed and announced except in a few instances. The planet Mars has been in unusually favorable position during 1926 for accurate astronomical observations. The distance separating it from the earth was slightly greater than at its last near approach in 1924. However, the planet this year was higher above the horizon, for northern observers, a fact which greatly facilitated telescopic observations.

Up to the date of writing this note, the only important Martian discovery announced by the world's observatories is the definite proof of the fact that the darker and lighter markings on the planet's surface are subject to change from time to time. One instance of this has been announced by Dr. E. M. Antoniadi, the experienced Martian observer of the Meudon Observatory, near Paris.* Other changes, affecting different parts of the planet from those observed by Dr. Antoniadi, have been recorded by Dr. W. H. Steavenson, also an experienced observer and the Martian specialist of the great Royal Observatory of Great Britain at Greenwich.†

Dr. Antoniadi and Dr. Steavenson agree that the darker markings on Mars alter from year to year both in size and in position, these alterations being of exactly the character which they would disclose were the darker markings composed of vegetation. It is now coming to be accepted generally by astronomers that this is the explanation of the Martian dark areas. The changes observed this year are due, on this theory, to

*Dr. Antoniadi's observations are referred to in a note entitled "News of Mars and of Jupiter" in *La Nature* (Paris), number 2740, supplement page 113 (October 9, 1926). Further observations at Meudon are summarized by M. Jarry-Desloges in "Contribution to the Study of the Planet Mars" (in French), Comptes Rendus de l'Académie des Sciences (Paris), volume 183, pages 1025 to 1026 (November 29, 1926).

†"Mars in 1926," by W. H. Steavenson. *Nature* (London), volume 118, pages 666-667 (November 6, 1926).



Yerkes Observatory

MARS HAS LIFE—BUT PROBABLY NO RADIO

The darker and lighter markings on the surface of Mars are well shown in these reproductions of photographs made a few hours apart by the late Professor E. E. Barnard, using the great 40-inch telescope of the Yerkes Observatory. Changes in these markings observed during the present approach of Mars have convinced astronomers that the planet harbors living vegetation. There is no evidence of intelligent beings who might be trying to reach us by radio.

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alterations in the average tracks of storms or in the prevailing directions of moisture-bearing winds. Such climactic changes would result, quite obviously, in the development of the areas of vegetation in somewhat different shapes and sizes.

It is probable that the combined observations of Mars during 1924 and 1926 will result in the definite acceptance by astronomers of the theory that Mars possesses, at the least, forms of life similar to our vegetation. Whether or not Mars harbors, in addition to this vegetation, anything that could be called animal life, or that could be considered similar to terrestrial intelligence, is still very much an open question. Still more doubtful is any possibility that Mars might be occupied by creatures acquainted with radio and either willing or able to attempt communication with us. Those radio enthusiasts who received this year, out of the trackless ocean of ether, the supposed mysterious signal "M" are, we fear, more the victims of their own enthusiasm than of any Martian scientist.

A Voice Against Railway-Train Radio

AN argument which deserves consideration in connection with the numerous recent proposals for the use of radio on railway trains is urged by Dr. J. H. Morecroft in his well-known department "The March of Radio," in a recent issue of *Radio Broadcast*.* Dr. Morecroft is not favorably impressed by the desirability of this extension of radio. Admitting that safety, as well as the convenient operation of trains, makes it desirable for some means of communication to be provided between the engineer and the rest of the train crew, Dr. Morecroft urges that this should be accomplished by means of wire lines, plugged together at the car couplings, instead of by radio.

The objection to radio is the possibility of interference with other radio operation and the general jamming of an ether already too full of radio impulses. A telephone system with detachable plugs at each car-end, in the same general manner as is now used for the air-hose, impresses Dr. Morecroft as being more suitable for this particular purpose. Although this Department has previously advocated the use of radio for railway train communication, it must be admitted that Dr. Morecroft's argument deserves careful consideration. His system retains, however, one important disadvantage now existing, and which a radio system might be arranged to cure. This is the impossibility of communication between the dispatcher's office, or other officials along the line, and the moving train.

*"Where Short Waves Are Not Needed." *Radio Broadcast* (Garden City, N. Y.), volume 10, page 149 (December, 1926).

The Relation of Ether Waves to Psychic Phenomena

SIR OLIVER LODGE has been for years a consistent advocate of the idea, none too popular among the rank and file of scientific men, that the universe contains non-material mysteries which it is the business of science to investigate.

That the so-called "pyschic" phenomena, if real, are in this field is one of Sir Oliver's beliefs; that the much-disputed ether is closely related to these phenomena he has several times suggested. Referring, in a recently published letter*, to a certain mysterious, although disputed, power of divination supposed to be possessed by gifted individuals, Sir Oliver says:

"There is an etherial environment too; and it may be that that is the home of the subconscious, in the same sense as matter is the home of the conscious part of our minds.

"I am myself inclined," he continues, "to think that we shall find ourselves more directly or immediately concerned or connected with the ether than we are with matter, in spite of the fact that matter looms so large to our familiar senses."

Most scientific men would be sceptical of the idea. Even the existence of the ether is doubted.

Nevertheless, Sir Oliver's ideas are always interesting. In the past, many of them, especially in radio, have proved to be true.

* "The Dowsing or Divining Rod," by Oliver Lodge. *Nature* (London), volume 119, page 387 (March 12, 1927).

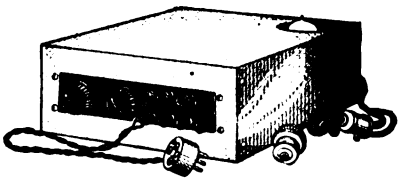
A New Biography of Electrons

THE lives and loves of atoms and electrons have become so important in many radio devices besides the vacuum tube that any new summary of the rapidly advancing knowledge in this realm of physics has its proper place in every radio library. For about two years Dr. Karl K. Darrow, of the Bell Telephone Laboratories, has been contributing to the publications of the telephone industry articles describing current advances in atomic physics and related fields. Some of these articles have now been collected, revised and expanded into a book which every physicist will find of interest.† Dr. Darrow has an unusual gift of clear and interesting expression without the sacrifice of accuracy. It is unfortunate that limitations of space prevented the inclusion in the new book of some of Dr. Darrow's papers dealing with radio waves and their close relatives.

† "Introduction to Contemporary Physics," by Karl K. Darrow. Published by D. Van Nostrand Company, New York City. 449 pages, 1926, $6.00.

VARION

Current Supply Unit



The parts making up the Varion Kit are manufactured by these leading manufacturers:

AMERICAN TRANSFORMER CO.
CENTRAL RADIO LABORATORIES
H. H. EBY MANUFACTURING CO.
SANGAMO ELECTRIC CO.
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200 volts output at 60 m. a. drain.
2 C-bias voltages, one variable from 0-45 volts.
A-current for 171 power tube available if desired.
16 mfds. of condensers assures reserve energy necessary for good reproduction.

At 100 m. a. drain, Varion passed the Raytheon Laboratories standard hum test.

Raytheon B H Rectifier

Centralab Heavy Duty Resistors

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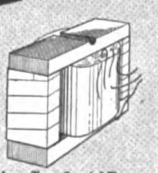
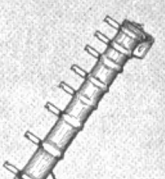
AmerTran Amerchoke #854



AmerTran Special Transformer, designed exclusively for Varion Current Supply Unit

Sangamo Wound Condenser Block



Ward Leonard Vitreous Enamelled Permanent Resistor

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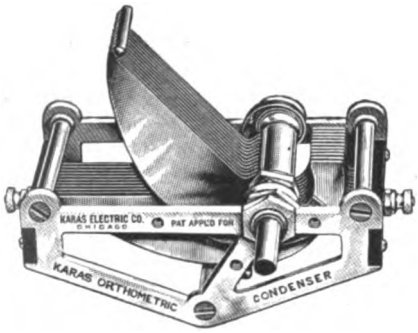

KARAS ORTHOMETRICS SPECIFIED FOR THE AERODYNE RECEIVER

THREE Karas .00037 Mfd. 17 Plate Orthometric Variable Condensers are specified by the Aero people for use in constructing the super-sensitive 5-Tube Aerodyne Receiver. This famous receiver has won a unique place for itself because of its remarkable performance and extreme selectivity under the most adverse conditions. Distant stations can be brought in through the heaviest kind of a local barrage; tuning is remarkably sharp.

The Aerodyne not only is an easy receiver to build, but it also is extremely easy to tune. The wide, even separation of wave lengths afforded by Karas Orthometrics makes tuning a pleasure. These condensers actually eliminate crowding from every part of the dials. Every point on the dial from 1 to 100 thus becomes a separate broadcasting wave length. For Orthometrics are strictly straight frequency line variable condensers. Each station is equally separated from its adjoining stations in both directions by 10 kilocycles, exactly as wave lengths are allocated by the Government.

Precision Built—the Karas Way

Orthometric Condensers have die-stamped solidly braced plates and frames of finest quality brass, and both rotor and stator plates are soldered at every contact point. Frame and rotor plates are grounded to eliminate body capacity. Rotor is held in cone bearings which permit easy, smooth action, yet with permanent alignment. Hard rubber dielectrics placed well outside of the effective electrostatic field eliminate absorption losses. Tests have shown that Orthometrics have no measurable losses—and resistance has been reduced to the absolute zero point within the limits of modern engineering.

Order Orthometrics for Your Aerodyne Today

Your dealer carries Orthometrics or can get them for you. If he is out of stock and you are in a hurry you may order direct from this advertisement by filling out and mailing the coupon. SEND NO MONEY. Merely hand the postman the price of the condensers plus a few cents postage. Start building your Aerodyne NOW.

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Send me 3 Karas 17 plate .00037 mfd. Orthometric Condensers, price $6.75 each, for which I will pay postman $20.25, plus postage, upon delivery.

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BROADCASTS

An Important Short-Wave Patent

WHILE our national law makers were fighting over the Radio Bill and while the newly-created Radio Commission was giving serious thought to the question of who should be allotted wavelengths, Dr. Reginald A. Fessenden, of Boston, Mass., of "hetrodyne" fame and a distinguished radio scientist, was recently granted patent No. 1,617,240 for a method of using wavelengths between 1 meter and 50 meters for directive signaling, a waveband which undoubtedly is being accorded serious interest by members of the "Radio Group."

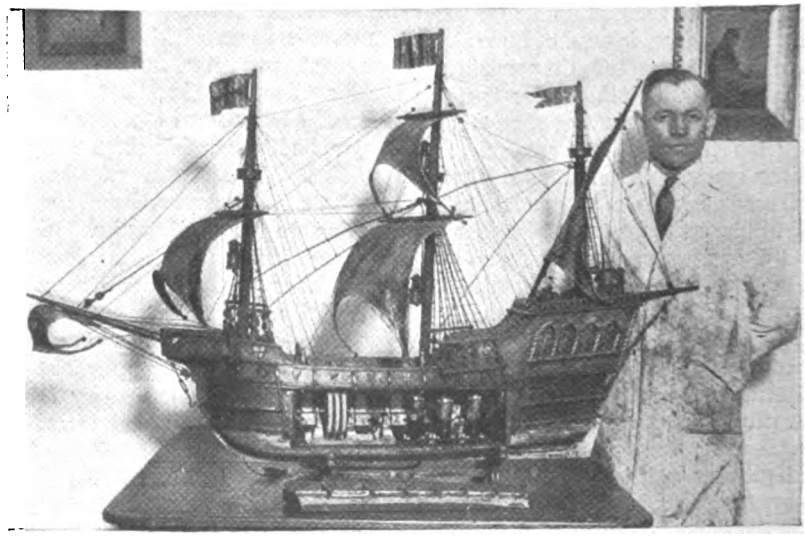
Dr. Fessenden states that his invention has for its object greater reliability of operation and the elimination of errors and disturbances.

During the years 1899-1918, Fessenden made many hundreds of experiments on methods of radio signaling on wavelengths varying from a few centimeters to more than six thousand (6000) meters. An account of these experiments, including the results obtained, was published by him, and will be found in the *Proceedings of the American Institute of Electrical Engineers*, November, 1899, and July 1908; *The Electrical Review*, London, May 11th and 18th, 1906, and February 15th, February 22nd and March 1st, 1907, and *The Electrician*, London, February 15th and 22nd, 1907, and December 19th, 1919.

Shortly after 1914, in connection with problems relating to aeroplane and submarine signaling where high masts, and therefore long wavelengths, could not be used, Dr. Fessenden investigated his records on the lower wavelengths—those between 300 meters and a few centimeters. As the use of wavelengths of a few centimeters was considerably worse than the use of wavelengths of 300 meters, he wished to know at exactly what point the diminution of efficiency began to occur.

To his great surprise, he discovered—what had hitherto been unsuspected by himself, and apparently by everyone else—that there was a good and efficient band of wavelengths lying between 50 meters and 1 meter.

He had, in the course of his experiments—and so, no doubt, had others—used wavelengths lying in this band, of



Keystone

THE CRAFTSMAN'S SKILL COMBINES WITH THE RADIO ART

How a radio receiver may be encased in a work of art is evidenced in this beautiful model of Columbus' flagship SANTA MARIA, *within which a complete five-tube receiving set is installed. Mr. Karl Bauer, seen at the right, is the experimenter who created this unique set.*

the order of 5 meters, but had never made the discovery of their extra efficiency, having attributed this efficiency to accidental variations; and it was not until the mass of results collected between 1899 and 1918 were tabulated and compared that he made the discovery.

The results could not be published at the time, as early in 1915 he received orders from both the United States Navy Department and from the War Department to the effect that inventions that have military uses should not be communicated by him to anyone except to certain designated officials, and the orders were that such secrecy must be maintained until the instructions were canceled "by competent authority." These orders were not canceled until several years after the close of the war.

The reason why this particular band is "transparent" is not known definitely by him, and so far no explanation has been given which has been accepted by scientists generally. There are no doubt a number of reasons, but whatever they may be, it is now certain, from the many recorded results of investigations made since he first disclosed the fact, that Dr. Fessenden's results are correct and that there is a band of wavelengths which is abnormally favorably to transmission and which is of the order of 5 meters.

The three claims allowed to Dr. Fessenden are as follows:

1. The method of obtaining increased transmission efficiency in directional radio signaling which comprises transmitting the signals by electric waves shorter than 50 meters in length and longer than 1 meter in length, such waves having a relatively high transmission characteristic whereby said signals are transmitted with much less disturbance by injurious atmospheric effects.

2. The method of obtaining increased transmission efficiency in directional radio signaling which comprises transmitting the signals by means of electric waves, of a band of wavelengths characterized by a high transmission efficiency, said band of wavelengths lying between 50 meters and 1 meter in length.

3. The method of obtaining increased transmission efficiency in directional radio signaling which comprises transmitting the signals on those wavelengths between 50 meters and 1 meter which effect a high transmission efficiency.

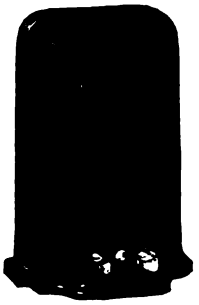
—WM. G. H. FINCH.

* *

Broadcast Station Changes Not Reported This Month

DUE to the fact that all licensing and relicensing of broadcasters was held up during April, pending the decision of the Federal Radio Commission, no reports of broadcast changes can be made in this issue of POPULAR RADIO. The reports will begin again as soon as the Commission begins issuing licenses.

Is your receiver up to the 1927 Standard of Tone Quality?



Type 285
Audio Transformer
285D (1 to 3 ratio)
285H (1 to 6 ratio)
PRICE $6.00 each

Type 373
Double Impedance Coupler
Price $6.50 each

A great many broadcast receiving sets in operation to-day are not up to the 1927 standard of tone quality. Yet, in other respects, such as sensitivity and selectivity they are reasonably efficient. If you are operating a receiver which answers this description, here are two suggestions for improving your audio amplifier, so that you may enjoy better radio reproduction without buying or building a new receiver:

1. Replace your old audio amplifier units by two General Radio Type 285 Transformers. A Type 285D (1 to 3) is recommended for the first stage, and a Type 285H (1 to 6) for the second:

or Substitute for your present amplifier a combination consisting of two stages of double impedance coupled and one stage of transformer coupled amplification. This combination requires two General Radio Type 373 Double Impedance Couplers and one Type 285D Transformer.

2. Use a UX-171 or CX-371 tube in the last audio stage. This tube will effect an improvement in tone quality due to the greater volume it will produce without overloading. When this tube is used, however, a device such as the *Type 367 Output Transformer* or Type 287A Speaker Filter is required to protect the loudspeaker from the flow of direct current.

Diagrams of the above mentioned amplifier circuits and folders fully describing the Type 285 Transformers, Type 373 Double Impedance Coupler, Type 367 Output Transformer, and Type 387A Speaker Filter will be sent upon request.

General Radio Co., Cambridge, Mass.

GENERAL RADIO
PARTS AND ACCESSORIES

TRUPHONIC *STANDARD* AMPLIFYING TUBES ARE DESIGNED ESPECIALLY FOR TRUPHONIC AUDIO AMPLIFICATION—AN H. P. DONLE DEVELOPMENT.

IN USING THIS MOST EFFICIENT FORM OF AMPLIFICATION—WHETHER BUILT INTO YOUR SET BY THE MAKER OR AS A SEPARATE UNIT—THE HIGHEST EFFICIENCY IS REACHED BY THE USE OF THESE TUBES.

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Complete

Marvelous Townsend "B" SOCKET Power Unit

only 4.95

$1.00 down Balance C.O.D.

Replaces "B" Batteries

Enjoy greatly improved reception and forget unreliable "B" battery nuisance. Every part in the Townsend "B" Socket Power Unit is made and assembled in our own factory. That is why we can give you a high grade instrument at a startingly low price, with a real guarantee of **money back if not satisfied.** Delivers up to 100 volts on any set, on direct or alternating current—any cycle. Full tone, clarity and volume. Just read these enthusiastic endorsements.

London, Ont., Canada.
I am very well pleased with your Eliminator. Since using it I have had many more stations and greater distance. —C. E. Bond.

Dewey, Okla.
I am more pleased with your Eliminator than I was with batteries. —B. E. Doureton.

Renovo, Penn.
I have received the Townsend Eliminator and it works fine. —Clarence Witchey.

Great Barrington, Mass.
I have given your Eliminator a good test and find it very good. —H. M. Miles.

Tested and approved by America's leading Radio authorities—Radio News and Popular Radio Laboratories.

ORDER TODAY!

Simply fill out the coupon and slip it into an envelope with only $1.00 and mail at once. Your Townsend "B" Socket Power Unit will be sent promptly. Deposit only $3.95 plus postage with the postman. Try out for 10 days—then if not delighted with improvement in reception, return it to us and purchase price will be refunded.

TOWNSEND LABORATORIES
713 Townsend St. Dept. 19 Chicago, Illinois

10 Days FREE TRIAL You are the Judge!

Attach only $1.00 to this Coupon!

SEND TODAY

TOWNSEND LABORATORIES.
713 Townsend St., Dept. 19
Chicago, Ill.

Gentlemen: Attached find $1.00. Kindly send at once Townsend "B" Socket Power Unit, C. O. D., for $3.95, plus postage, on guaranteed 10-day free trial.

Name.....

Address.....

.....State.....

Broadcasting Stations Warned Against Quacks

QUACKS are turning to radio as a new and modern means of extracting money from the gullible, it is indicated in a warning sent to broadcasting stations throughout the country by the National Better Business Bureau and its affiliated local bureaus. These advices have done much to protect the listener-in from inspired promotions. A recent warning sent to Washington, D. C., broadcasting stations by the local bureau is directed against a western cancer institution which has been criticized by medical associations as a "quackery." This institution has recently appealed to radio stations in the country for space on the air. Reports received here indicate that the promoters are meeting with very little success, due largely to the notices sent out and to the caution exercised by radio station managers to protect their unseen audience.

* *

A Radio Medical Code for the Sea

AN international radio medical code to aid doctorless ships at sea in the diagnosis and treatment of diseases is being prepared by the American Code Company, in collaboration with steamship lines and New York medical men. The passing of medical advice from shore to ship and from ship to ship, first practised by the Seaman's Church Institute, has grown to such an extent that some universally understandable code is needed to make this sort of communication easy and exact. According to F. A. Hall, a representative of the American Code Company, the outline of a book to be used in treating diseases in accordance with advice received by the code has been prepared.

* *

Labor Opposes Air Property Rights

"ORGANIZED labor is unalterably opposed to property rights on the air, maintaining that this new medium of communication and entertainment must be developed and utilized for the benefit of all the people and not as a source of profit for corporation, private or political interest." This is the substance of an address delivered before the Federal Radio Commission. by Edward M. Nockles, representing the labor cooperative broadcasting station WCFL. Mr. Nockles maintained that the medium of radio communication—the ether—was not the product of capital or labor, but a "God-given" natural resource; hence its use should be determined by the great body of radio listeners, and not by any moneyed group of promoters or advertisers.

* *

The Decline of Interest in the Broadcasting of Jazz

IN answer to a questionnaire sent to broadcast fans three years ago, according to Mr. Frank A. Arnold, director of development of the National Broadcasting Company, 75 per cent of those who answered expressed a preference for jazz. In answer to a similar questionnaire sent out recently, only 5 per cent expressed a preference for this form of broadcast entertainment. The answers indicated a marked inclination toward programs made up of classical and semi-classical music and educational features.

Keystone

GERMAN OPERA FOR A GERMAN PFENNIG

Radio does all the work for this 1927 model of Berlin organ grinder; all he need do is tune in his portable receiver on a good broadcast program and then stand by while the coins drop. It may not be as romantic as the old hand organ, but it's a great deal easier—on the organ grinder and on the audience.

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For the Beginner FREE HAND BOOK with Popular Radio

Kendall Banning, Editor, and **Laurence M. Cockaday**, Technical Editor of POPULAR RADIO, have compiled a book that will prove to anyone that he can build a set which will give distance, selectivity and tone volume, and at the same time a very definite basic knowledge of radio.

BUILD YOUR OWN SET AND SAVE MONEY

In "How to Build Your Radio Receiver," you will find complete specifications, constructional diagrams, photographs and instructions for building all of the following sets:

A $5 Crystal Set
The Haynes Single-Tube Receiver
A Two-Stage Audio-frequency Amplifier
The Cockaday 4-Circuit Tuner
A 5-Tube Tuned Radio-frequency Receiver
The "Improved" Cockaday 4-Circuit Tuner
The Regenerative Super-Heterodyne Receiver

ADVISORY SERVICE ALSO FREE

POPULAR RADIO maintains a big modern laboratory with a trained staff of investigators under the personal supervision of Mr. Cockaday. This Laboratory is always available through our Technical Service Bureau to answer, free to subscribers, by personal letter, any problems you encounter which are not answered in either the "Handbook" or the magazine.

SPECIAL BOOK OFFER

You can secure a copy of "How to Build Your Radio Receiver" FREE and have all the privileges of the Technical Service Bureau without additional expense, if you will send a remittance of $3.00 in full payment of 12 months' subscription for POPULAR RADIO. (Or as an alternative, you may have the book and privileges of the Technical Service Bureau with POPULAR RADIO for 7 months only—for $2.00. A two dollar bill will do.)

Remember you take no chance—we will refund your money in full if you are not more than satisfied.

POPULAR RADIO
Department 35
627 West 43rd Street, New York

FREE SIMPLIFIED BLUE PRINTS

You know how helpful, interesting and practical POPULAR RADIO is. You fully appreciate that at $3.00 a year it is a real bargain. Consequently, you should find it easy to convince one, two or more of your friends, who are not now subscribers, of the unusual value when any one of these sets of Simplified Blueprints is offered free with their twelve months' subscription for POPULAR RADIO at the regular price of $3.00. In addition to the Blueprints given to your friends we will allow you one set free for each *new* subscription you send us with a $3.00 remittance. Five new subscriptions and remittance of $15.00 would entitle you to five sets free.

Only one set of Blueprints free with a renewal subscription whether your own or a friend's.

POPULAR RADIO, INC., Dept. 35
627 West 43rd Street, New York City
Enclosed is my remittance of $.....covering .....annual subscription for POPULAR RADIO (names on sheet attached). Send me set(s) checked below.

☐ Set No. 18 ☐ Set No. 24
☐ Set No. 22 ☐ Set No. 25
☐ Set No. 23 ☐ Set No. 26
☐ Set No. 27

Name.....

Address.....

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Foreign postage 50c extra. No extra for Canada.

Transoceanic Calls Heard

THE following stations were received and logged at the amateur station of J. Mousset (EF-8JMS) at 14 Rue de Beaune, Paris, France, with a cage antenna, 8 by 6 meters, and a Bourne low-loss receiver:

U-1OR—Nov. 9, 1926; signal strength R-4; calling CQ on 41 meters; good note; no interference or fading;
U-1AAR—Nov. 9, 1926; signal strength R-6; calling CQ on 40 meters; good note; no fading;
U-9XL—Nov. 12, 1926; signal strength R-6; calling IDA on 41 meters; good note; no fading;
U-9GEW—Nov. 12, 1926; signal strength R-8; calling CQ on 39 meters; good note; no fading;
U-2GS—Nov. 13, 1926; signal strength R-4; calling CQ on 40 meters; good note; no fading;
U-2NZ—Nov. 13, 1926; signal strength R-7; calling CQ on 40 meters; good note; no fading;
U-8SF—Nov. 13, 1926; signal strength R-7; calling CQ on 40 meters; good note; no fading;
U-3JO—Nov. 13, 1926; signal strength R-5; communicating with F-8YOR on 42 meters; good note; no fading;
U-4IC—Nov. 13, 1926; signal strength R-5; calling U-4TX on 40 meters; good note; no fading;
U-8ADM—Nov. 13, 1926; signal strength R-4; calling CQ on 41 meters; good note; no fading;
U-3AU—Nov. 14, 1926; signal strength R-4; calling CQ on 42 meters; good note; no fading;
C-3AFO—Jan. 17, 1927; signal strength R-7; good note on 40 meters; no fading;
C-3ADC—Jan. 17, 1927; signal strength R-4; good note on 40 meters; no fading;
C-3ACI—Jan. 21, 1927; signal strength R-3; good note on 40 meters; no fading;
C-3AFB—Jan. 24, 1927; signal strength R-5; good note on 39 meters; no fading;
C-3AEA—Feb. 2, 1927; signal strength R-2; weak signals with fading;
C-3AM—Feb. 3, 1927; signal strength R-5; good note on 40 meters; no fading;
C-3BH—Feb. 7, 1927; signal strength R-8; very fine, strong note on 37.3 meters; no fading;
C-3AGB—Feb. 11, 1927; signal strength R-2; calling on 39.8 meters; weak signals accompanied by fading.

THE amateur station of Russell S. Morton (U-3CEC), using an antenna and counterpoise and a three-circuit regenerative detector set with one stage of low-frequency amplification, logged station OA-2YJ, April 10, 1927. Signal strength R-3; rectified AC note; very bad static.

A Radio Slander Law

IT is reported that Congressman Dickstein of New York will introduce at the next session of Congress an amendment to the 1927 Radio Law to prevent the broadcasting of matter known to be false or defamatory to any individual, organization, race or religious belief.

The Official BROWNING-DRAKE KIT SET

THE life of the average radio design offered to the home builder has been a few months. Rarely has a design endured over a year without undergoing radical changes. Browning-Drake's popularity has increased with every passing year, ever since its presentation in the summer of 1924. Three years have elapsed, yet no radical changes or improvements in the Browning-Drake design have been necessary to maintain its popularity.

This April, a standard design known as the Official Browning-Drake Kit Set, incorporating refinements to take care of present broadcasting conditions and make the set adaptable to power units and "B" eliminators, was presented to the radio public. This Official Kit Set is now standard on the market.

To obtain the rare Browning-Drake performance, be sure you get the Official Browning-Drake Kit, Foundation Unit, Neutralizer and Resistance Cartridge, products of the Browning-Drake Corporation, together with the approved parts of associate manufacturers, which are handled by reputable radio dealers. Get your parts TODAY and build the Official Browning-Drake Kit Set.

DEALERS: Twice as many Browning-Drake Kits are sold as those designed for any other set. We will be glad to forward the name of our nearest jobber.

Browning-Drake Corp.
Brighton Mass.

BROWNING-DRAKE RADIO

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Leutz-Universal Transoceanic

A Powerful Nine Tube Receiver

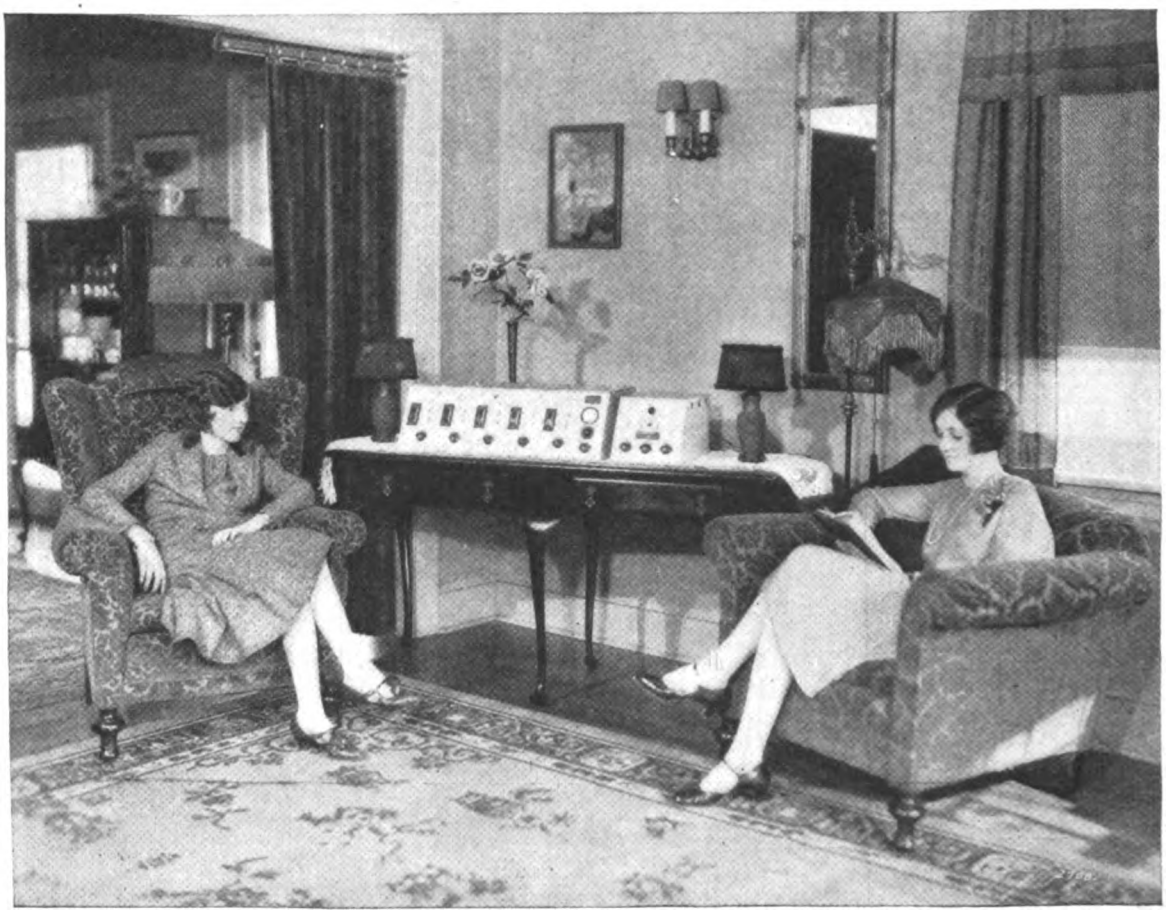

Table Installation Universal Transoceanic and Current Supply

Universal Transoceanic Receivers have now been shipped to every State in the Union, every Province of Canada, and to Mexico, Ecuador, New Zealand, Australia, Spain, Portugal, Italy and many other foreign countries.

Reports from customers fully substantiate our broad claims in every respect.

New literature covering this model is now being mailed to our regular mailing list.

We will be glad to send you a copy upon request.

C. R. LEUTZ, Inc.

6th and Washington Aves., Long Island City, New York, U.S.A.

CABLE: EXPERINFO

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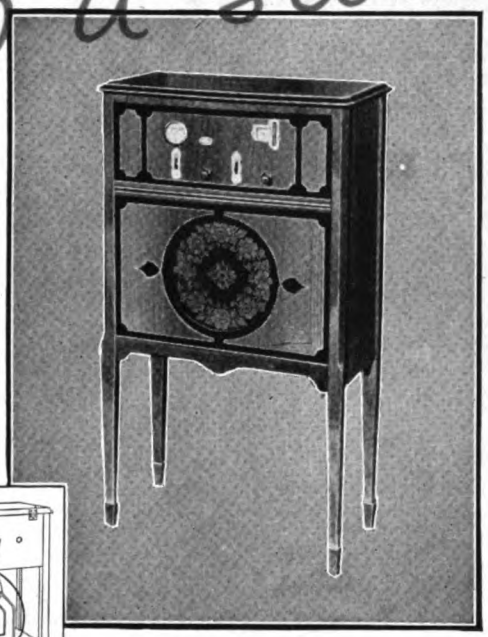
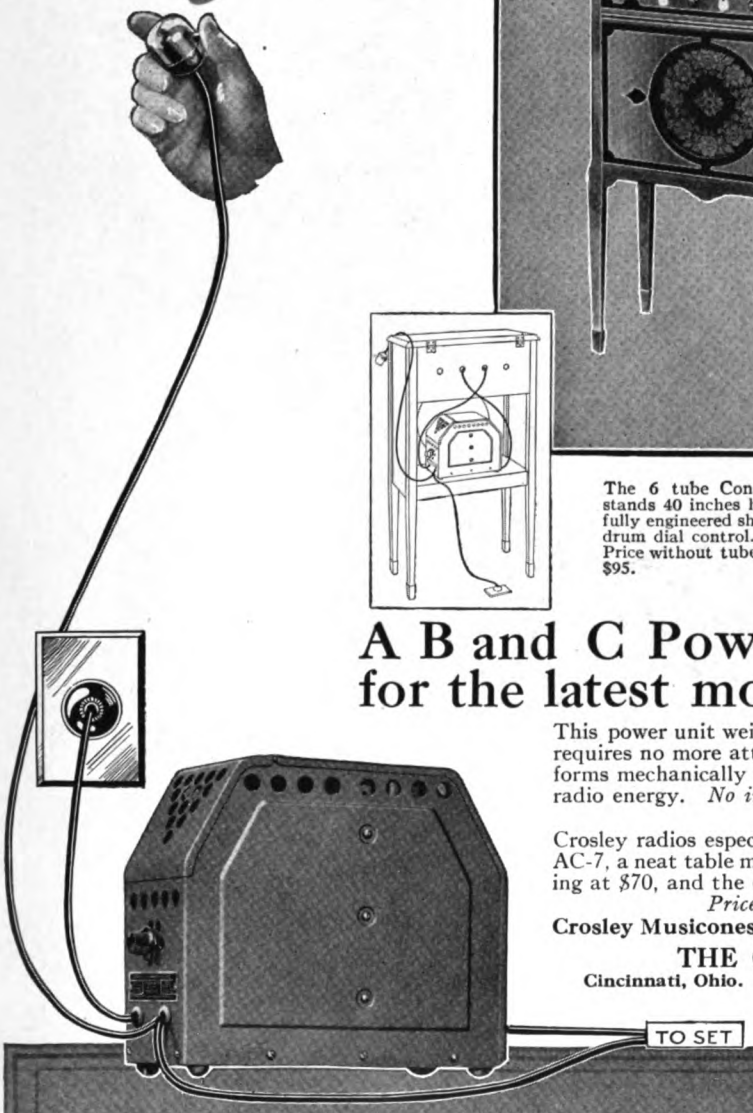
Snap a switch



The 6 tube Console pictured above stands 40 inches high—contains skillfully engineered shielded circuit—single drum dial control. Musicone built in. Price without tubes and power unit—$95.

- **No more batteries**
- **No battery charger to watch**
- **No batteries to water**
- **No failure of the power plant just as you sit down to a fine program**
- **No upsetting the house to have the radio serviced**
- **No apologies to make to callers that the batteries have just run down**
- **No batteries to recharge**
- **No batteries to renew**



A B and C Power from the light socket for the latest model Crosley A C Radios

This power unit weighs 13 lbs., stands 9 inches high and is 4 inches wide and requires no more attention than a vacuum cleaner or an electric iron. It transforms mechanically ordinary 110 volt 60 cycle house current into smooth, quiet radio energy. *No interfering hum!*

Price $50

Crosley radios especially designed to use this battery eliminator are the 6 tube AC-7, a neat table model of the famous Crosley single drum control receiver selling at $70, and the 6 tube console model AC-7-C pictured above at $95.

Prices slightly higher west of the Rocky Mountains.

Crosley Musicones $9.75 and $14.75. ***Write Dept. 16 for descriptive literature.***

THE CROSLEY RADIO CORPORATION

Cincinnati, Ohio. **Powel Crosley, Jr., Pres.**

Crosley sets are licensed under Armstrong U. S. Patent No. 1,113,149 or under patent applications of Radio Frequency Laboratories, Inc., and other patents issued and pending.

CROSLEY

BETTER — COSTS LESS

RADIO

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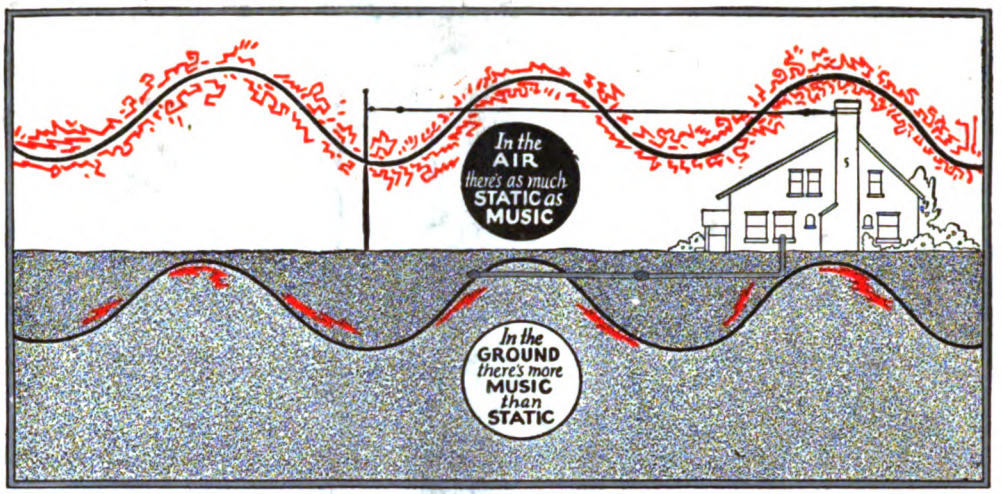


Use STATIC-FREE Ground Waves Get Distance Loud and Clear all Summer

SUBANTENNA—new underground Antenna System astounds listeners and laboratories with loud, clear reception on hot summer nights when old style aerial brings in unwanted noise

IMAGINE the intense pleasure of bringing in your favorite distant station loud and crystal clear—right thru summer's curtain of static and noise! But you don't have to be content with merely imagining it. Real DX in summertime—real big volume—amazing clarity—much better selectivity—all these are now available to you—and, with your present set. Simply connect your set to SUBANTENNA—the marvelous new underground antenna system that uses filtered ground waves instead of noisy air waves.

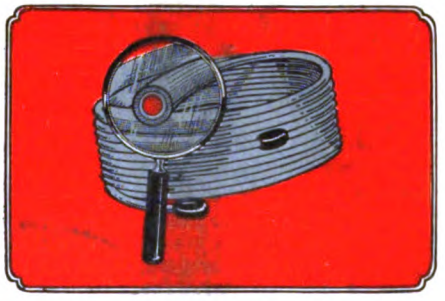
Read PROOF that SUBANTENNA is the Greatest New Thing in Radio

Static Is No More

"I have received the Subantenna. My grandson installed it. STATIC IS NO MORE. Am well satisfied. I can tune in stations I never could coax out of the air even though I had a long aerial."—A. E. F., Kans.

Better Selectivity—No Static

"It has always been impossible for me to eliminate the Drake Hotel. I was told that Subantenna would enable me to do this. Although skeptical, in view of many similar claims made by other manufacturers of radio accessories, I had one of the Subantennas installed. The results have been most satisfactory, in that I have not only been able to



get every station in Chicago of any consequence, when the Drake was on the air, but out-of-town stations as well. In addition I am able to report that static which was a source of much annoyance before, has been entirely eliminated so far as I am able to observe."—R. L. P., Chicago.

Michigan Gets California

"I have had KFI California several times and go all over U. S. A. to Portland, Maine. You have the goods. It is far better for volume and tone on loud speaker than outside aerial."—C. J. S., Mich.

Why SUBANTENNA Makes Every Night a Good Radio Night

In summer *air*, the ratio of static strength to signal strength favors static. The "noise" is so much greater than the broadcast signal that it sometimes hides the music you wish to hear. That's why you don't get distance in the summertime. But, when you use SUBANTENNA, the situation is just reversed. For, in the ground, the ratio of static strength to signal strength favors the latter. In fact, there is so little static in the ground that the broadcast signal easily dominates it, with the result that you don't hear the static. Radio research men have long known this fact, but no device had ever been perfected by which ground waves could be used. Now, however, you have SUBANTENNA—a great new device which makes radio, for the first time, an all year 'round pleasure.

Eliminates Lightning Risk

Not only will SUBANTENNA give you loud, clear reception in summer—not only will this remarkable invention better the selectivity of your set—but it also completely eliminates the lightning hazard. With SUBANTENNA you can go right on listening in during the most severe electrical storm without fear of attracting lightning or damaging your set.

FREE TRIAL

Make This Convincing Test

Install SUBANTENNA. Leave your old aerial up. Select a bad night when DX is almost impossible with the ordinary aerial. Make a comparison station for station, connecting first your aerial, then SUBANTENNA. If from stations that are just a mess of jumbled noise with the old aerial, you don't get reception that rivals local in sweetness and clarity the instant you switch the SUBANTENNA, this test won't cost you even a single penny. Send coupon at once for scientific explanation of SUBANTENNA and for particulars of GUARANTEE and FREE TRIAL OFFER. Send COUPON NOW!

SUBANTENNA

Underground Antenna System

CLOVERLEAF MFG. CO.

2714-W CANAL STREET CHICAGO, ILLINOIS

CLIP AND MAIL AT ONCE

Cloverleaf Mfg. Co.,
2714-W Canal St., Chicago.

Tell me all about SUBANTENNA, your unqualified, unconditional guarantee and your FREE TRIAL OFFER.

Name.....

Address.....

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Listen to SUBANTENNA Static Eliminators over KYW Chicago 536 meters every Wednesday night 7:30 to 8 P. M. Central Daylight Saving Time

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